**UNIVERSITY OF KERALA**

# SCHEME AND SYLLABUS

# (OUTCOME BASED)

# FIRST DEGREE PROGRAMME IN CHEMISTRY

**(BSc)**

**UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM**

**Core Courses, Foundation Course II, Open and Elective Courses**

**2020 ADMISSION ONWARDS**

**UNIVERSITY OF KERALA**

**SCHEME AND SYLLABUS**

**FIRST DEGREE PROGRAMME (BSc) IN CHEMISTRY**

**2020 ADMISSION ONWARDS**

The BSc Degree programme in Chemistry covers three academic years of six semesters and aims to provide the students with an in-depth understanding and training in chemical sciences. The syllabus has been designed to stimulate the interest of the students in chemistry and prepared in order to equip the students with a potential to contribute to the academic and industrial requirements of the society. The new, updated syllabus is in accordance with the **OUTCOME BASED EDUCATION (OBE)** which aim at acquiring advanced knowledge in Chemistry as a discipline, in an interdisciplinary way. Based on the new guidelines of OBE, **Programme Outcome (PO)** ***for the First degree Programme is defined by University of Kerala***. **Programme Specific Outcome** relating to BSc Chemistry **(PSO)** and **Course Outcome (CO)** relating to each course are also specified. [CO is of the Remember level(R) understand level(U) and apply level(A) based on Blooms Taxonomy]

Chemistry being an experimental science, due importance is given to the development of laboratory and instrumentation skills. The student is acquainted with the method of science, research methodology and the use of Computational softwares and Cheminformatics thus developing basic skills and knowledge of computing and data based decision making. At the same time, emphasis is given to critically analyse the impact of Chemistry in the present scenario of emerging human friendly and ecofriendly green approach in various facets of life and to become cautious against the random usage of dangerous chemicals.

It also provides a detailed knowledge of the terms, concepts, methods, principles and experimental techniques of chemistry, in order to get a comprehensive knowledge in leading a better life in harmony with nature.

**PROGRAMME SPECIFIC OUTCOME (PSO) FOR FDP IN CHEMISTRY**

| Sl.No. | Upon completion of BSc Degree programme in Chemistry, students | PSO No. |
|---|---|---|
| 1 | Develop scientific outlook scientific attitude and scientific temper | PSO1 |
| 2 | Develop skill in experimenting , analyzing and interpreting data | PSO2 |
| 3 | Develop research attitude and adopt scientific method of identifying, analyzing and solving research problems in an innovative way | PSO3 |
| 4 | Apply physical and mathematical theories and principles in the context of chemical science | PSO4 |
| 5 | Use chemistry related soft wares for drawing structure and plotting graphs | PSO5 |
| 6 | Use instruments- potentiometer, conductometer, pH meter and colorimeter. | PSO6 |
| 7 | Acquire skill in safe handling of chemicals including hazardous materials. | PSO7 |
| 8 | Identify the ingredients in household chemicals, use them in a critical way | PSO8 |
| 9 | Predict analytical procedures, compare experimental, theoretical and graphical methods of analysis | PSO9 |
| 10 | Predict reaction mechanism in organic reactions | PSO10 |
| 11 | Understand the terms, concepts, methods, principles and experimental techniques of physical, organic, inorganic and analytical chemistry | PSO11 |
| 12 | Develop critical thinking and adopt healthier attitudes towards individual, community and culture through the course of Chemistry | PSO12 |
| 13 | Become cautious about environmental aspects and impact of chemicals in soil, water and air and adopt ecofriendly approach in all frontiers of life | PSO13 |
| 14 | Become responsible in consumption of natural resources and adopt measures for sustainable development. | PSO14 |
| 15 | Visit Chemical factories and industries with scientific curiosity | PSO15 |
| 16 | Develop writing skills and presentation skills using audio visual aids | PSO16 |
| 17 | Compare and share knowledge in an interdisciplinary manner | PSO17 |
| 18 | Inculcate spirit of originality, novelty, and necessity in scientific research | PSO18 |
| 19 | Contribute to the academic and industrial requirements of the society | PSO19 |
| 20 | Get motivated to higher studies - PG Degree in different branches of Chemistry, BEd Degree in Physical Science, and job opportunities in industrial and non industrial sectors | PSO20 |
| 21 | Adopt safer life skills in a human friendly and ecofriendly way | PSO21 |

## COURSE STRUCTURE

The First Degree programme in Chemistry comprises of fourteen core courses, one project course, two choice based courses ( an Open course in V$^{th}$ semester and an Elective course in VI$^{th}$ semester), one core specific foundation course (II$^{nd}$ semester) in addition to one area-specific foundation course, the complementary courses and language courses. The open course offered in the fifth semester is open to students from other Majors. The details of the Course Structure are given in **Table I to VI**.

A Computer Skill Development Programme is included as part of the Core Course-CH1221 (Foundation Course II in Semester II), for computational skill development with no End Semester Evaluation (ESE).

**FIRST DEGREE PROGRAMME**
**IN CHEMISTRY**
**Table I : Course structure, Scheme of Instruction and Evaluation**

| Course Code | Study component | Instructional hrs/Week | | Credit | Duration of Uty. Exam | Evaluation marks | | Total Credit |
|---|---|---|---|---|---|---|---|---|
| | | T | P | | | CE | ESE | 18 |
| EN1111 | English I | 5 | | 4 | 3hrs | 20 | 80 | |
| 1111 | Additional Language I | 4 | | 3 | 3hrs | 20 | 80 | |
| EN1121 | Foundation Course I | 4 | | 2 | 3hrs | 20 | 80 | |
| MM1131.2 | Complementary Course I | 4 | | 3 | 3hrs | 20 | 80 | |
| PY1131.2 | Complementary Course II | 2 | | 2 | 3hrs | 20 | 80 | |
| | Complementary Course Lab of PY1131.2 | | 2 | - | - | - | - | |
| CH1141 | Core Course I | 2 | | 4 | 3hrs | 20 | 80 | |
| | Core Course Lab I of CH1141 | | 2 | - | - | - | - | |
| **SEMESTER II** | | | | | | | | |
| EN1211 | English II | 4 | | 3 | 3hrs | 20 | 80 | 18 |
| EN1212 | English III | 5 | | 4 | 3hrs | 20 | 80 | |
| 1211 | Additional Language II | 4 | | 3 | 3hrs | 20 | 80 | |
| CH1221 | Foundation Course II | 2 | 2 | 3 | 3hrs | 20 | 80 | |
| MM1231.2 | Complementary Course III | 4 | | 3 | 3hrs | 20 | 80 | |
| PY1231.2 | Complementary Course IV | 2 | | 2 | 3hrs | 20 | 80 | |
| | Complementary Course Lab of PY1231.2 | | 2 | - | - | - | - | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **SEMESTER III** | | | | | | | | |
| EN1311 | English IV | 5 | | 4 | 3hrs | 20 | 80 | 18 |
| 1311 | Additional Language III | 5 | | 4 | 3hrs | 20 | 80 | |
| MM1331.2 | Complementary Course V | 5 | | 4 | 3hrs | 20 | 80 | |
| PY1331.2 | Complementary Course VI | 3 | | 3 | 3hrs | 20 | 80 | |
| | Complementary Course Lab of PY1331.2 | | 2 | - | - | - | - | |
| CH1341 | Core Course II | 3 | | 3 | 3hrs | 20 | 80 | |
| | Core Course Lab I of CH1341 | | 2 | - | - | - | - | |
| **SEMESTER IV** | | | | | | | | |
| EN1411 | English V | 5 | | 4 | 3hrs | 20 | 80 | 24 |
| 1411 | Additional | 5 | | 4 | 3hrs | 20 | 80 | |
| | Language IV | | | | | | | |
| MM1431.2 | Complementary | 5 | | 4 | 3hrs | 20 | 80 | |
| | Course VII | | | | | | | |
| PY1431.2 | Complementary Course VIII | 3 | 2 | 3 | 3hrs | 20 | 80 | |
| | Complementary Course Lab of PY1131.2 PY1231.2 PY1331.2 & PY1331.2 | | | 4 | 3hrs | 20 | 80 | |
| CH1441 | Core Course III | 3 | | 3 | 3hrs | 20 | 80 | |
| CH1442 | Core Course IV- Lab I of CH1141 | | 2 | 2 | 3hrs | 20 | 80 | |
| **SEMESTER V** | | | | | | | | |
| CH1541 | Core Course V | 3 | | 4 | 3hrs | 20 | 80 | 19 |
| CH1542 | Core Course VI | 4 | | 4 | 3hrs | 20 | 80 | |
| CH1543 | Core Course VII | 4 | | 4 | 3hrs | 20 | 80 | |
| CH1544 | Core Course VIII Lab II | | 5 | 3 | 6hrs | 20 | 80 | |
| CH 1545 | Core CourseIX Lab III | | 4 | 2 | | 20 | 80 | |
| 1551 | Open Course | 3 | | 2 | 3hrs | 20 | 80 | |
| | Project | | 2 | - | - | - | - | |
| **SEMESTER VI** | | | | | | | | |
| CH1641 | Core Course X | 3 | | 4 | 3hrs | 20 | 80 | 23 |
| CH1642 | Core Course XI | 4 | | 4 | 3hrs | 20 | 80 | |
| CH1643 | Core Course XII | 4 | | 4 | 3hrs | 20 | 80 | |
| CH1644 | Core Course XIII Lab IV | | | 3 | 6hrs | 20 | 80 | |
| CH1645 | Core Course XIV Lab V | | | 2 | | 20 | 80 | |
| CH1661.1/ CH1661.2/ CH1661.3/ CH1661.4 | Elective Course | 3 | | 2 | 3hrs | 20 | 80 | |
| CH1646 | Project and Factory Visit | | 3 | 4 | Viva voce | - | 100 | |

CE -Continuous Evaluation, ESE- End Semester Evaluation

**Table I A. Total number of Courses offered in BSc programme**

| Sl No. | Courses | No. of courses | Credits semester wise |
|---|---|---|---|
| 1 | Language Courses | 9 | 7+10+8+8=33 |
| 2 | Foundation Courses | 2 | 2+3=5 |
| 3 | Complementary Courses | 9 | 5+5+7+11=28 |
| 4 | Core Courses | 14 | 4+3+5+17+17=46 |
| 5 | Open Course | 1 | 2 |
| 6 | Elective Course | 1 | 2 |
| 7 | Project | 1 | 4 |
| Total number of Courses | | 37 | |
| Total number of credits in all six semesters | | 18+18+18+24+19+23=120. | 120 |

**Table II.Scheme of instruction of Core Courses, Foundation Course II, Open Course and Elective Course**

| Course No. Course code | Course Title | Sem I | | Sem II | | Sem III | | Sem IV | | SemV | | Sem VI | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Hrs L/P | C | Hrs L/P | C | Hrs L/P | C | Hrs L/P | C | Hrs L/P | C | Hrs L/P | C | Hrs | **C** |
| C.C.I CH1141 | Inorganic Chemistry I | 2/2 | 4 | | | | | | | | | | | 2 | **4** |
| F.C.II CH1221 | Chemistry-its Origin, Methodology and Impacts | | | 2/2 | 3 | | | | | | | | | 4 | **3** |
| C.C.II CH1341 | Inorganic Chemistry II | | | | | 3/-- | 3 | | | | | | | | **3** |
| C.C.III CH1441 | Organic Chemistry I | | | | | | | | | | | | | | **3** |
| C.C.IV CH1442 | Lab I of CH1141,CH1341&CH1441 (Inorganic Qualitative Analysis) | | | | | --/2 | | --/2 | 2 | | | | | 6 | **2** |
| C.C.V CH1541 | Physical Chemistry I | | | | | | | | | 3/-- | 4 | | | 3 | **4** |
| C.C.VI CH1542 | Inorganic Chemistry III | | | | | | | | | 4/-- | 4 | | | 4 | **4** |
| C.C.VII CH1543 | Organic Chemistry II | | | | | | | | | 4/-- | 4 | | | 4 | **4** |
| C.C.VIII CH1544 | Lab II of CH1541,CH1542&CH1543 (Inorganic Volumetric Analysis) | | | | | | | | | --/5 | 3 | | | 5 | **3** |
| C.C.IX CH1545 | Lab III of CH1541,CH1542&CH1543 (Physical Chemistry Experiments) | | | | | | | | | --/4 | 2 | | | 4 | **2** |
| O.C CH1551 | Open to other majors | | | | | | | | | 3/-- | 2 | | | 3 | **2** |
| C.C.X CH1641 | Physical Chemistry II | | | | | | | | | | | 3/-- | 4 | 3 | **4** |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C.CXI CH1642 | Organic Chemistry III | | | | | | | | | | | 4/-- | 4 | 4 | **4** |
| C.CXII CH1643 | Physical Chemistry III | | | | | | | | | | | 4/-- | 4 | 4 | **4** |
| C.C.XIII CH1644 | Lab Course IV (Organic Chemistry Experiments) | | | | | | | | | | | --/5 | 3 | 5 | **3** |
| C.C.XIV CH1645 | Lab Course V (Gravimetric Experiments) | | | | | | | | | | | --/3 | 2 | 3 | **2** |
| E.C CH1661 | Any one of the options | | | | | | | | | | | 3/-- | 2 | 3 | **2** |
| C.C.XV CH1646 | Project | | | | | | | | | --/2 | | --/3 | 4 | 5 | **4** |
| | Factory visit | | | | | | | | | | | | | | |
| **Credits/Semester** | | **4** | | **3** | | **3** | | **5** | | **19** | | **23** | | | **57** |

C.C-Core Course, F.C-Foundation Course, O.C-Open Course, E.C-Elective Course
L-Theory, P-Practical, C-Credit

**B.Sc. Degree Programme in Chemistry**

**Table III. Open Course offered to students of other disciplines**

**Semester V**

| Semester | No. of Hours / Week | | Credits | Course Code | Title of the Course | Instructional Hours |
|---|---|---|---|---|---|---|
| | L | P | | | | |
| V | 3 | - | 2 | CH1551.1 | Chemistry and its Application | 54 |
| | | | | CH 1551.2 | Fundamentals of Chemistry & Its Application to Everyday Life | |
| | | | | CH 1551.3 | Environmental Chemistry | |

**B.Sc. Degree Programme in Chemistry**

**Table IV. Elective Course offered in Semester VI**

| Semester | No. of Hours / Week | | Credits | Course Code | Title of the Course | Instructional Hours |
|---|---|---|---|---|---|---|
| | L | P | | | | |
| VI | 3 | - | 2 | CH1661.1 | Supramolecular, Nano Particles and Green Chemistry | 54 |
| | | | | CH 1661.2 | Computational, Combinatorial and Physical Organic Chemistry | |
| | | | | CH 1661.3 | Polymer chemistry | |
| | | | | CH 1661.4 | Biochemistry | |

**Table V. Complementary Courses offered to BSc Chemistry (One Semester 18 weeks)**

**(Complementary programme - Mathematics, Total Credits – 14)**

| Semester | Hours/week | Number of Credits | Course code | Instructional Hours |
|---|---|---|---|---|
| I | 4 | 3 | MM1131.2 | 4×18 = 72 |
| II | 4 | 3 | MM1231.2 | 4×18 = 72 |
| III | 5 | 4 | MM1331.2 | 5×18 = 90 |
| IV | 5 | 4 | MM1431.2 | 5×18 =90 |

**Table VI. Complementary Courses offered to BSc Chemistry (One Semester 18 weeks)**

**Complementary Programme- Physics , Total Credits – 14**

| Semester | Hours/Week | | Number of Credits | Course code | Instructional Hours |
|---|---|---|---|---|---|
| | L | P | | | |
| I | 2 | 2 | 2 | PY1131.2 | 2×18 = 36<br>2×18 = 36 |
| II | 2 | 2 | 2 | PY1231.2 | 2×18 = 36<br>2×18 = 36 |
| III | 3 | 2 | 3 | PY1331.2 | 3×18 = 54<br>2×18 = 36 |
| IV | 3 | 2 | 3<br>4 | PY1431.2<br>PY1432.2 | 3×18 =54<br>2×18 = 36 |

## GENERAL ASPECTS OF EVALUATION

### MODE OF EVALUATION - COMMON TO CORE, ELECTIVE, COMPLEMENTARY AND FOUNDATION COURSES

Evaluation of each course shall involve Continuous Evaluation (CE) of 20 marks and End Semester Evaluation (ESE) of 80 marks.

### 1. CONTINUOUS EVALUATION FOR LECTURE COURSES

The Continuous evaluation will have 20 marks and will be done continuously during the semester.

CE components are

(i) Attendance for lecture and laboratory sessions (to be noted separately where both lecture and laboratory hours have been specified within a course);

(ii) Assignment /seminar and

(ii) Test

The distribution of marks is shown below. There will be two class tests for which, the better of the two marks obtained will form part of CE. Seminar for each course to be organized by the course teacher and assessed along with a group of teachers in the Department. The topic selection by the student for assignments/seminar will be with the approval of the course teacher.

| No | Component | Marks |
|---|---|---|
| **1** | Attendance | 5 |
| **2** | Assignment / Seminar | 5 |
| **3** | Tests | 10 |
| **Total** | | **20** |

### 1.1. EVALUATION OF THE ASSIGNMENTS AND SEMINAR

The topic selection by the student for assignments/seminar will be with the approval of the course teacher.

The assignment can be

1. A report of about 4-6 pages in A4 size paper
2. The topic can be presented either as oral or as power point for 10 minutes duration using audio-visual aids if available. The seminar is to be conducted within the contact hour allotted for the course.
3. Preparing Charts on assigned topic
4. Making static or working models.

The submitted report /chart /models should be evaluated for assignment marks.

| Mode of Assignments / Seminar Evaluation | | |
|---|---|---|
| **No** | **Main Component** | **Marks** |
| **1** | Adherence to overall structure & submission deadline | All four main components present & satisfactory : 5<br><br>Only three : 4<br>Only two : 3<br>Only one : 2 |
| **2** | Content & grasp of the topic | |
| **3** | Lucidity / Clarity of presentation | |
| **4** | References / Interaction/Overall effort | |

## 1.2 QUESTION PAPER PATTERN FOR CONTINUOUS EVALUATION TESTS

- The theory examination has a duration of 1.5 hours and a maximum mark of 40
- Questions should be 20% hard, 60% medium and 20% easy.

1. Each question paper has three sections: A, B & C
2. Section A has ten compulsory- one word/one sentence questions carrying 1 mark each .
3. Section B contains twelve short questions of which 7 questions have to be answered. Each question carries 2 marks.
4. Section C contains nine questions of which 4 has to be answered. Each question carries 4 marks.

   The answer must contain at least 8 points (Short Essay type).
5. 30% of the questions in physical chemistry papers should be problem based.

| Question Paper Pattern for CE Test | | |
|---|---|---|
| Question No | Type of Question | Marks |
| Section A: 1-10 | All / one word/one sentence | 1X10=10 |
| Section B: 11-22 | 7out of 12; Short Answer | 7 X2=14 |
| Section C: 23-31 | 4 out of 9; Short Essay | 4 X4= 16 |

| | |
|---|---|
| TOTAL | 40 marks |

| DETAILS OF ESE FOR LAB COURSES | | | | | |
|---|---|---|---|---|---|
| Lab Course | Course name | ESE | Time | Total Marks 100 | |
| | | | | CE | ESE |
| Lab course I | Inorganic Qualitative analysis | IV Semester | 3Hrs | 20 | 80 |
| Lab course II | Inorganic Volumetric analysis | V Semester | 3Hrs | 20 | 80 |
| Lab course III | Physical chemistry experiments | V Semester | 3Hrs | 20 | 80 |
| Lab course IV | Organic Chemistry Experiments | VI Semester | 3Hrs | 20 | 80 |
| Lab course V | Gravimetric Experiments | VI Semester | 3Hrs | 20 | 80 |

## 1.3 CONTINUOUS EVALUATION FOR LABORATORY COURSES

The Continuous evaluation will have 20 marks. The ESE of inorganic qualitative analysis will be done only in the IV semester and similarly the ESE of physical chemistry experiments and volumetric analysis will be done only in the V semester. The ESE of Organic and Gravimetric experiments will be done at the end of VI semester.But the corresponding CE are calculated from all the semesters in which there is attendance for laboratory sessions.

| No | Component | Marks |
|---|---|---|
| **1** | Attendance | 5 |
| **2** | Lab test | 5 |
| **3** | Record | 5 |
| **4** | Punctuality | 5 |
| **Total** | | **20** |

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## 1.4 EVALUATION OF THE RECORD

On completion of each experiment, a report should be presented to the course teacher as soon as the experiment is over. It should be recorded in a bound note-book. The experimental description should include aim, principle, materials/apparatus required/used, method/procedures, and tables of data collected, equations, calculations, graphs, and other diagrams and the final results.

| CE for Lab report &Laboratory Record * | | |
|---|---|---|
| **No** | **Sub Component** | **Marks** |
| **1** | Punctual submission and Neat presentation | All four sub-components present & satisfactory : 5 |
| **2** | Record of more than 90% experiments in the syllabus | Any three : 4 marks |
| **3** | Calculations and absence of errors/mistakes | Only two : 3 |
| **4** | Accuracy of the result | Only one : 2 |

***The LAB RECORD of experiments, certified by the tutor and HOD is compulsory for the ESE**

## 2. GUIDELINES FOR QUESTION PAPER SETTERS FOR ESE

- The theory examination has a duration of 3 hours
- The maximum marks is 80 for each theory paper.
- Question paper should contain 20% Remember (R) ,60% Understanding (U) and 20% Application (A) Level questions.
- Questions should be as per the syllabus from the standard text books mentioned in syllabus
- Question paper setter should submit a detailed scheme of evaluation along with question paper.

### QUESTION PAPER PATTERN (ESE)

1. Each question paper has four Sections: A, B , C and D
2. Section A has ten compulsory- one word/one sentence questions carrying **1** mark each .
3. Section B contains twelve short questions of which eight questions have to be answered. Each question carries **2** marks with four points (Short Answer type ).
4. Section C contains nine questions of which six has to be answered. Each question carries **4** marks. The answer must contain at least 8 points (Short Essay type).
5. Section D contains four questions of which the candidate has to answer two. Each question should have **three subdivisions** with a total of **15** marks.

| Question Paper Pattern for ESE | | |
|---|---|---|
| Question No | Type of Question | Marks |
| Section A: 1-10 | 10 one word/one sentence | 1x10=10 |
| Section B: 11-22 | 8 out of 12; Short Answer | 2x8=16 |
| Section C: 23-31 | 6 out of 9; Short Essay | 4x6=24 |
| Section D: 32-35 | 2 out of 4 | 15x2=30 |
| **Total** | | **80 marks** |

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**
**2020 Admission onwards**

| | |
|---|---|
| Semester | I |
| Course | Core course-I |
| Course name | **INORGANIC CHEMISTRY I** |
| Course Code | CH 1141 |
| Credit | 2 |
| Hours | 36 hours |
| Lecture-Tutorial-Lab | 2-0-2 |

| CO No. | **COURSE OUTCOME** *Upon completion of this course, the students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Discuss the course of development of structure of atom. | U | PSO1 |
| 2 | Apply rules for filling electrons in classifying elements into s, p,d and f blocks | A | PSO10 |
| 3 | Define various scales of electronegativities and their applications | U | PSO10 |
| 4. | Define Effective nuclear charge and Slater's rules | U,A | PSO10 |
| 5 | Discuss about diagonal relationship and anomalous behaviour of hydrogen and other first element in each group. | U | PSO4 |
| 6 | Correlate and predict general properties of s and p block elements based on their electronic configuration. | A | PSO4 |
| 7 | Realise applications of s and p block elements in sustainable and renewable energy sources. | A | PSO14 |
| 8 | Define various concepts of acids and bases. | U | PSO11 |
| 9 | Understand reactions in non aqueous solvents. | U | PSO11 |
| 10 | Realise various causes, effects and control measures of environmental pollution. | E | PSO13 |
| 11 | Review national movements for environmental protection. | U, A | PSO21 |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **1** | **Atomic Structure and Periodicity** | **9** | |
| 1.1 | Introduction to structure of atom, Rutherford and Bohr model of atom, | 1 | 1 |
| 1.2 | Dual nature of electron-de Broglie equation-matterwaves and electromagnetic waves. Experimental verification by Davis and Germer method,Heisenberg's uncertainty principle- expression and significance. | 1 | 1 |
| 1.3 | Wave mechanical concept of the atom-Schrodinger | 1 | 1 |

| | | | |
|---|---|---|---|
| | equation and its significance (derivation not required.) | | |
| 1.4 | Quantum numbers- Pauli's Exclusion principle- Aufbau Principle- Hund's rule- Electronic configuration of atoms- classification of elements into s,p,d and f blocks- | 2 | 1 |
| 1.5 | Electronegativity- Pauling's scale, Mulliken and Allred-Rochow scale(including numerical problems), | 2 | 4 |
| 1.6 | Effective nuclear charge, Slaters rule and its applications, diagonal relationship and anomalous behavior of first element with other elements. | 2 | 4,5 |
| **2** | **Representative elements** | **9** | |
| 2.1 | General properties of s and p block elements, Hydrogen – isotopes and its applications- uses as a fuel, water gas | 2 | 6 |
| 2.2 | Physical properties- atomic radii, ionization enthalpy, electron negativity, electron affinity, Flame colouration, inert pair effect | 2 | 6 |
| 2.3 | Chemical properties- solubility and thermal stability of alkali and alkaline earth metal oxides, sulphates and hydrides | 2 | 6 |
| 2.4 | p-block elements- oxides of nitrogen and phosphorus, oxyacids of halogens | 1 | 6 |
| 2.5 | Allotropism – carbon, sulphur and phosphorus | 1 | 6 |
| 2.6 | Applications- lithium battery, cesium in photovoltaic cells, selenium in xerography and barium x-ray | 1 | 7 |
| **3** | **Acids, Bases and non- aqueous solvents** | **9** | |
| 3.1 | Arrhenius concept, Lowery –Bronsted, Lewis concepts and Lux Flood concept and its limitations, | 2 | 8 |
| 3.2 | SHAB principle and its applications, | 1 | 8 |
| 3.3 | Non – aqueous solvents: General properties- classifications- self ionization and leveling effect- | 2 | 9 |
| 3.4 | Reaction in non-aqueous solvents- protic and aprotic non-aqueous solvents- examples-solutions of metal s in liquid ammonia- self ionization of liquid ammonia-liquid $SO_2$, liquid HF, alkali metals in liquid ammonia. | 4 | 9 |
| **4** | **Environmental chemistry- Air, water and soil pollution** | **9** | |
| 4.1 | Air pollution- Air pollution caused by fire works, harmful effects of fire works, acid rain, green house effect, smog- classic and photochemical smog | 2 | 10 |

| | | | |
|---|---|---|---|
| | Ozone layer depletion, ozone hole, protection of ozone umbrella. Management of air pollution. | | |
| 4.2 | Water pollution: causes- heat, industrial waste, sewage water, detergents, agricultural pollutants<br>Treatment of industrial waste water- Activated charcoal, synthetic resins, reverse osmosis and electro dialysis<br>Quality of drinking water- Indian Standard and WHO standard- Dissolved oxygen- BOD , COD. | 3 | 10 |
| 4.3 | Soil pollution: pesticides, fertilizers, Industrial waste, Plastic.<br>Control of Plastic threat- importance of Plastic identification codes and Plastic recycling, use of biodegradable plastics (PGA,PLA and PHBV(mention only) | 2 | 10 |
| 4.3 | Control of pollution. Pollution Control Board – Duties and responsibilities<br>Mention environmental movements (Plachimada,Silent valley, movement against Endosulfan, Narmada Bachavo Andolan and Chipko movement) | 2 | 11 |

**Text Books**


1. B.R.Puri, L.R,.Sharma, K.C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers New Delhi,2010
2. F.A.Cotton, G. Wilkinson, Advanced Inorganic Chemistry, Wiley, India(P)Ltd
3. J.D.Lee, Concise Inorganic Chemistry,5$^{th}$Edn. Wiley, India(P)Ltd.
4. A.K.De,Environmental Chemistry,New Age International(P) Ltd. New Delhi
5. A.K.Ahluwalia, Environmental Chemistry, Ane Books, India, New Delhi.


**For Further Reading**


1. M.C.Day and J Selbin, Theoretical Inorganic Chemistry,2$^{nd}$ Edn.,Reinhold Book Corp.
2. S.Prakash,G.D.Tuli, S.K Basu, R.D.Madan,Advanced Inorganic Chemistry, Vol. 1.,S Chand
3. J.E.Huheey,E.A.Keiter, R.L.Keiter, O.K.Medhi. Inorganic Chemistry, 4$^{th}$ Edn. Pearson, 2006
4. S.S.Dara, A Textbook of Environmental Chemistry and Pollution Control, 8$^{th}$ Edn. S Chand& Sons, New Delhi.
5. M.N.Greenwood, A .earnshaw, Chemistry of the Elements, 2$^{nd}$ Edn. Butterworth, 1997.

**UNIVERSITY OF KRALA**
**Model Question Paper of B.Sc. Chemistry First Degree Programme**

**2020 Admission onwards**
**SEMESTER -I Core Course-1 Course Code - CH1141 Credit-4**

## INORGANIC CHEMISTRY I

**Time: 3 Hours** **Maximum Marks: 80**

### SECTION A

(Answer **all** questions in one word/one sentence. Each question carries **1** mark)

1. Mention about the flame colouration of II group elements.
2. Write an example of classic smog.
3. State Heisenberg's uncertainty principle.
4. What are matter waves?
5. Which is the conjugate base of HF.
6. Define covalent radius.
7. Write the reason for eutrophication.
8. In the stratosphere, fluorine from the CFC's change to which compound.
9. Name the radio isotope of hydrogen?
10. Mention any one use of alkali metals. **(1 X 10 = 10marks)**

### SECTION B

(Answer any **8** questions. Each question carries **2** Marks)

11. Calculate the wavelength of electron moving with a velocity of $10^6$ $ms^{-1}$.
12. A cricket ball weighing 100g is to be located within 0.1$A^o$. What is the uncertainty in its velocity?
13. What are eigen values and eigen functions?
14. How first element differs from other elements in a group?
15. What is COD?
16. What are ortho and para hydrogens.
17. Write SHAB principle?
18. Comment about the hydration of alkali metals?

19. State and illustrate Pauli's Exclusion Principle.

20. Distinguish between levelling solvents and differentiating solvents.

21. Write a note on green house effect.

22. What is acid rain? **(2 X 8 = 16marks)**

## SECTION C

(Answer any **6** questions. Each question carries **4**Marks)

23. Discuss the following reactions in liquid $SO_2$.

(i) Solvation (ii) acid- base reaction

24. Discuss hydrogen and water gas as fuels.

25. Describe reverse osmosis for water purification.

26. Briefly explain about the Davisson and Germer's experimental verification of wave nature of electron.

27. What is smog? What are the different types of smog?

28. How ozone layer is depleted?

29. What is the trend of Ionization enthalpy and electron gain enthalpy in the periodic table?

30. What are hydrides? Explain.

31. Discuss about the redox property of alkali metals

**(4 X 6 = 24marks)**

## SECTION D

(Answer any **2** questions. Each question carries **15** Marks)

32. (a) What is effective nuclear charge? Explain with example.

(b) Write a note on various electronegativity scales

(c) Explain about the various rules for filling up of electrons in orbitals. (5+5+5 Marks)

33. (a) Write a note on allotropes of carbon.

(b) Discuss on the topic 'hydrogen as next generation fuel'

(c) Give an account of Cesium in photo voltaic cell and Lithium battery (5+5+5 Marks)

34. (a) What are the common characteristics of solvents?

(b) Liquid ammonia is a better solvent for organic compounds. Why?

(c) Write a note on various concepts of acids and bases. (5+5+5 Marks)

35 .(a) Briefly discuss about the various air pollutants

(b) Fertilizers and pesticides pollute soil. Justify.

(c) Explain about the various water quality parameters (5+5+5 Marks)

**(15 X 2 = 30marks)**

**SYLLABUS FOR B.Sc. CHEMISTRY PROGRAMME**
**2020 admission onwards**

| | |
|---|---|
| Semester | II |
| Course | Foundation course II |
| Course name | **CHEMISTRY –ITS ORIGIN, METHODOLOGY AND IMPACTS** |
| Course Code | CH 1221 |
| Credit | 2 |
| Hours | 36 hours |
| Lecture-Tutorial-Lab | 2-0-2 |

| **CO no.** | **COURSE OUTCOME** *Upon completion of this course, the students* | **Cognitive level** | **PSO** |
|---|---|---|---|
| 1 | Appreciate the development of scientific theories through years with specific examples | U | PSO1 |
| 2 | Develop curiosity and scientific attitude towards the application of chemistry in daily life | C | PSO1 |
| 3 | Outline a procedure for experimentation | A | PSO2 |
| 4 | Appraise the current development in Chemistry | E | PSO1 |
| 5 | Identify the common ingredients of house hold synthetic products | U | PSO8 |
| 6 | Discriminate and classify chemicals used as drugs,explosives, | U | PSO7 |
| 7 | Get motivated in visiting chemical Industries | E | PSO15 |

| | | | |
|---|---|---|---|
| 8 | Adopt safety measures in handling chemicals | A | |
| 9 | Draw titration curves and explain theory of volumetric titrations | A | PSO2/PSO3 |
| 10 | Select suitable indicators for acid base titration knowing the theories of acid base titration and indicators | A | PSO11 |
| 11 | Develop computational skills | A | PSO5 |
| 12 | Discuss separation techniques of filtration and chromatographic techniques | U | PSO3 |

R-Remember, U-Understand, A-Apply

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **1** | **Evolution of Chemistry as a discipline of science** | **3** | |
| 1.1 | Evolution of Chemistry - ancient speculations on the nature of matter, early form of chemistry-alchemy. | 1 | 1 |
| 1.2 | Major contributions of Friedrich Wöhler, Mendeleev, Michael Faraday and Marie Skłodowska-Curie | 1 | 2 |
| 1.3 | Scope of Chemical Science, branches of Chemistry<br>Basic idea of Chemistry as a central science connecting Physics , Biology and other branches of science | 1 | 2 |
| **2** | **Impact of Chemistry in human life** | **9** | |
| 2.1 | **Food Chemistry**: Food additives, preservatives, anti oxidants, commonly used permitted and nonpermitted food colours<br>artificial sweeteners-taste enhancers,<br>Health effects of fast foods, instant foods, dehydrated foods and junk foods, 'trans fat' | 2 | 2 |
| 2.2 | **Cleansing agents:** Soaps- Hard and soft soaps, alkali content-TFM, Detergents , Shampoos (Common ingredients and health aspects )<br>**Cosmetics**: talcum powder, lip sticks, nail polish, moisturiser , hair dye, Sun screen lotions(Common ingredients and health aspects ) | 1 | 5,6,7 |
| 2.3 | **Role of Chemistry in sustainable development**<br>Role of chemical industries in polluting the environment, limitations of conventional waste management, birth of green chemistry | 2 | 2 |
| 2.4 | **Solar energy harvesting** : | 1 | 2 |

| | | | |
|---|---|---|---|
| | Photosynthesis,<br>Photovoltaic cell, conventional solar cells,<br>nano structured solar cells | | |
| 2.5 | **Green solvents:**safer solvents - water, Super Critical fluids(CO2), ionic liquids, advantages of SCF | 1 | 2 |
| 2.6 | **Chemistry in the field of Medicine** (Elementary idea only)<br>Radio active tracers in diagnosis and treatment of cancer: use of Radio isotopes($^{60}$Co, $^{131}$I )<br>Use of MRI scanning,<br>Dialysis in blood purification.<br>advantages and disadvantages in using these techniques | 2 | 6 |
| **3** | **Methods and Tools of Science & Research methodology** | **6** | |
| 3.1 | Basis for scientific laws and factual truths– hypothesis observations- experimental proofs. Theories and laws | 1 | 1 |
| 3.2 | Experimentation - Design of an experiment, data collection – types of data -interpretation and deduction –repeatability and replication- Accuracy and precision, Revision or modification of scientific theories and laws | 1 | 3 |
| 3.3 | Research methodology, scientific method of conducting research: Selecting and defining a problem, Science Journals, Impact factor, citation, ISSN, ISBN. | 1 | 4 |
| 3.4 | *Educational softwares – INFLIBNET, NICNET, BRNET, NPTEL, VIRTUAL LABS OF MHRD academic services<br>*Chemistry related softwares-Chem sketch and Chem Draw for structure drawing,<br>*Chemical Databases-Pubchem, ZINC, Cambridge Structural Database (CSD),<br>*Molecular visualization tools –Avogadro, Molden, Molekel,<br>*File format-PDB and CIF<br>*Graphical tools- Excel and Origin (*elementary idea only with computer assistance).<br>. | 2 | 11 |
| 3.5 | Study of the latest/current Nobel prize winners in chemistry | 1 | 4 |

| | | | |
|---|---|---|---|
| **4** | **Analytical Principles and techniques** | **9** | |
| 4.1 | Inorganic qualitative analysis –Common ion effect and solubility product and their application in the precipitation of cations in a mixture.<br>Introduction of Microscale analysis as a green chemistry approach | 2 | 3 |
| 4.2 | Quantitative Analysis:Theory of acid-base titration - titration curve of strong acid-strong base ,weak acid – strong base, strong acid- weak base and weak acid- weak base, theory of acid-base indicators | 2 | 10 |
| 4.3 | Theory of Redox titration: Titration of $Fe^{2+}$ with $KMnO_4$ and $K_2Cr_2O_7$ and theory of redox indicators | 1 | 10 |
| 4.4 | Theory of complexometric titration: metal ion-EDTA titration. Theory of metallochromic indicators<br>Precipitation titration: NaCl- AgNO3 titration and use of potassium chromate as adsorption indicator | 1 | 10 |
| 4.5 | Chromatography - classification of methods - Elementary study of adsorption chromatography<br>Column and thin layer- partition chromatography-paper- ion exchange and gas chromatographic methods | 1 | 12 |
| 4.6 | Gravimetric Analysis - Mechanism of precipitate formation - Factors affecting solubility of<br>precipitates – co-precipitation and post precipitation - Effect of digestion - washing, drying and ignition of precipitates. | 2 | 3 |
| **5** | **Chemistry and industry** | **3** | |
| 5.1 | Cement: Introduction, types of cement , manufacture, chemical composition of Portland cement, setting and hardening of cement and special cement | 1 | 6,7 |
| 5.2 | Ceramics: Introduction, types of clay products, properties of clay, plasticity of clay, manufacturing of white wares and stone wares and their application | 1 | 6,7 |
| 5.3 | Paints: Primary constituents, binders and solvents, requirements of a good paint-oil based paints, latex paints, luminescent paints, fire retardant paints and heat resistant paints<br>Pigments**:** definition, White lead, lithopone, ultramarine, red lead, Guignet's green and chrome yellow | 1 | 6,7 |
| **6** | **Lab Safety measures and disaster management** | **6** | |
| 6.1 | Introduction to lab safety-regulatory requirements-labels, | 1 | 5,8 |

| | | | |
|---|---|---|---|
| | material safety. Knowledge of hazard warning information and symbols. | | |
| 6.2 | Propellants and Explosive compounds ,Examples- TNT,TNG,Urea nitrate,Hydrazine derivatives. potentially dangerous mixtures- Flammable solvents, ignition sources used in laboratories, metal hydrides(basic idea) | 2 | 2 |
| 6.3 | Reactive inorganic substances and their toxicity (strong acids, bases, halogens, chromates). Hazards due to chemicals, toxic-solids, liquids, gases, and other harmful substances - carcinogenic substances. | 2 | 2 |
| 6.4 | Emergency procedures in chemical splashes to skin and eyes, burns and electric shock. | 1 | 8 |

**Textbooks**


1 N.C. Datta, "The Story of Chemistry" , University Press.
2. B K Sharma, Industrial chemistry, 11th edition, Goel Publishing House, Meerut, 2000
3. B Srilakshmi, Food Science,5th edition, New Age Publishers, NewDelhi,2010
4.Kirpal Singh, Chemistry in Daily Life, PHI Learning Pvt.Ltd, 201
5. Muhammed Musa, Gaji, Abhishek Varma,(Editors)"Development of Solar power generation and energy harvesting", **ISBN 9789351249498**, Publisher Astral
6. Medicinal Chemistry , An introduction, II nd edition Gareth Thomas, Wiley
7. Hazards in chemical laboratories and guide to safe practices in chemical laboratories published by Royal Society of Chemistry
8. A. I. Vogel, "Text book of Quantitative Inorganic Analysis
9. Day& Underwood "Quantitative analysis: laboratory manual


**Further reading**


1. H.Collins and T.Pinch ,The Golem : What everyone should know about science, Cambridge Univ Press 1993
2.R T Mishra, Teaching of information Technology.
3.M Ravikumar, Information Technology for Higher Education
4.Fletcher,Gilbert , Radiation therapy in the management of cancers;
5.http://www.vlab.co.in
6.http://nptel.iitm.ac.in/
7. V. Rajaram, Introduction to Information Technology , Prentice Hall

8. Barbara Wilson, Information Technology, The Basics, Thomas Learning
9.Calvin W Tayler and Frank Barron Scientific Creativity : Its Recognition and Development

10. A.H Ahluwalia,Renu Aggarwal, Comprehensive Practical organic chemistry Renu Aggarwal, 2000, Universities press.
11.T.F.Gieryn, Cultural boundaries of science Univ. Chicago Press 1999
12.MSR Winter, A Consumer's dictionary of cosmetic ingredients, 7th edition, Three Rivers Press, NewYork,2009

**UNIVERSITY OF KERALA**

**Model Question Paper of B.Sc. Chemistry Programme**
**2020 Admission onwards**
**SEMESTER –II Course Code - CH 1221**
**Foundation course II**
**CHEMISTRY-ITS ORIGIN, METHODOLOGY AND IMPACTS**

**Time: 3 Hours** **Maximum Marks: 80**

**SECTION A**

Answer all Questions in one word to maximum of two sentences

**Each question carries one mark**

1. Name two interdisciplinary branches of chemistry.
2. State and explain the term alchemy.
3. Define the term repeatability.
4. Define hypothesis.
5. Name a redox indicator?
6. Define Rf value
7. Name an artificial sweetener.
8. Write one example ionic liquid.
9. Draw two symbols for hazardous chemicals.
10. What are propellants?

10x1 = 10 marks

**SECTION B**

**Short answer type** (Not to exceed one paragraph)
Answer any 8 questions from the following.
**Each question carries two marks**

11. Write any two contributions by the scientist Marie Curie?
12. Name any two databases and molecular visualization tools in chemistry?
13. State the difference between accuracy and precision.
14. Write the importance of ISSN and ISBN.
15. How micro scale analysis support green chemistry?
16. What are metallochromic indicators?
17. What are the errors occurring in gravimetric analysis?
18. Explain two educational softwares.
19. What are food additives?
20. How solar energy is trapped naturally?
21. What do you mean by' trans fat'?
22. Write short note on ceramics.

**8×2 = 16** marks

## SECTION C

**Short essay** (Not to exceed 120 words)
Answer any 6 questions from the following.
**Each question carries four marks**

23. What are soaps. How are they classified? Discuss the parameters to check the quality of soap.
24. Write a note on research methodology.
25. How will you plot a standard curve using excel sheet?
26. Describe the theory behind redox titration with one example?
27. Explain the different steps in gravimetric analysis?
28. Write a short note on the contributions of latest Nobel laureates in chemistry.
29. Briefly explain 1) MRI, 2) dialysis
30. Discuss the importance of plastic recycling in the present scenario.
31. Discuss the principle of paper chromatography.

**6× 4 = 24** marks

## SECTION D

Answer any two questions from the following
**Each question carries fifteen marks**

32. a. Discuss on green solvents.
    b. Write the importance of research journals?
    c). What are the major contributions of Faraday, Medeleeve and Wohler in chemistry? (5+5+5)
33. a)Discuss the application common ion effect in the inter group separation of cations.
    b)Describe the manufacture of cement and the chemistry of setting.
    c)Differentiate between propellants and explosives. Give examples (5+5+5)

34. a) Discuss on paints, classification and constitution.
b)Write note on white lead, lithopone and ultramarine
c)Explain the different methods of harvesting solar energy (5+5+5)

35.Explain the safety measures to be adopted in the laboratory?

b)Briefly discuss on microscale analysis as a green chemistry approach.
c)Discuss on metal ion EDTA complexation and its application (5+5+5)

**2×15 = 30** marks

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**

**2020 Admission onwards**

| | |
|---|---|
| Semester | III |
| Course | Core course-II |
| Course name | **INORGANIC CHEMISTRY II** |
| Course Code | CH 1341 |
| Credit | 3 |
| Hours | 54 hours |
| Lecture-Tutorial-Lab | 3-0-2 |

| CO No. | **COURSE OUTCOME**<br>*Upon completion of this course, the students.* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Understand various theories of chemical bonding and their limitations. | U | PSO4 |
| 2 | Predict stability of atoms and the nature of bonding between atoms. | U,A | PSO4 |
| 3 | Discuss various applications of intermolecular interactions | U | PSO4 |
| 4. | Understand chemistry of glass, silicates and silicones | U | PSO7<br>PSO8 |
| 5 | Discuss chemistry of Boron compounds, oxyacids and oxides of Phosphorous | U | PSO11 |
| 6 | Understand refractory carbides, nitrides, borides and silicides. | U | PSO11 |
| 7 | Describe various types of halogen compounds. | U | PSO3 |
| 8 | Understand chemistry of noble gas | U | PSO3 |
| 9 | Understand inorganic polymers and their applications. | U | PSO8 |
| 10 | Distinguish between types of nuclear reactions. | U | PSO11 |
| 11 | Describe measurement of radioactivity. | U | PSO2<br>PSO3 |
| 12 | Discuss applications of radioactivity in various fields. | U | PSO3 |
| 13 | Understand introductory concepts of nanochemistry | U,A | PSO18 |
| 14 | Suggest methods of synthesizing nano materials. | U | PSO18 |
| 15 | Appreciate the variety of applications of nanomaterials. | U ,A | PSO18 |

R-Remember, U-Understand, A-Apply

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **1** | **Chemical Bonding I** | **9** | |
| 1.1 | VSEPR theory and its applications- structure of molecules with bond pairs only, molecules with both bond pairs and lone pairs- | 3 | 1 |
| 1.2 | valence bond theory- conditions of overlapping- types of overlapping(positive , negative and zero overlapping), hybridization-methane, ethylene, benzene,acetylene, allenes, $sp^3d$ and $sp^3d^2$- limitations of VBT. | 3 | 1 |
| 1.3 | MO theory, LCAO, homonuclear diatomic molecules- $C_2$, $B_2$, $N_2$, $O_2$ and ions like $O_2^+$ - heteronuclear diatomic molecules(HF, NO and CO)-calculations of bond order and its applications. | 3 | 1 |
| **2** | **Chemical Bonding II** | **9** | |
| 2.1 | Types of bonding- ionic bond- ionic lattice energy of ionic compounds- Bond –Lande equation, Born – Haber cycle, salvation energy and solubility of ionic solids, covalent character of ionic bond, Fajan's rules | 2 | 2 |
| 2.2 | Polarity of covalent bond- dipole moment- percentage of ionic character- dipole moment and molecular structure. | 2 | 2 |
| 2.3 | Metallic bonding- free energy theory, VB theory and band theory (Qualitative treatment only) – | 1 | 2 |
| 2.4 | Secondary forces- hydrogen bond, inter and intramolecular hydrogen bond, Applications-intermolecular interactions- ion-dipole-van der Waal's forces such as dispersion forces, dipole-dipole, ion – induced dipole, dipole induced dipole. | 4 | 2, 3 |
| **3** | **Compounds of non- transition elements I** | **9** | |
| 3.1 | Manufacture and uses of the following Glass- different types of glasses, silicates, zeolites and silicones. | 4 | 4 |
| 3.2 | Borax- boron hydrides, boron nitrides, borazole and carboranes, | 2 | 5 |
| 3.3 | Oxides and oxyacids of phosphorus. | 1 | 6 |
| 3.4 | Refractory carbides, nitrides, salt like carbides, borides and silicides. | 2 | 7 |
| **4** | **Compounds of non- transition elements II** | **9** | |
| 4.1 | Oxides and oxyacids of halogens (structure only) – inter halogen compounds and pseudo halogens- | 3 | 8 |
| 4.2 | Noble gases-uses, Xenon compounds–structure and hybridization in Xenon fluorides. | 2 | 9 |
| 4.3 | Inorganic polymers, phosphorus, boron and silicon based polymers- structure and industrial applications. | 4 | 10 |
| **5** | **Nuclear chemistry** (numerical problems expected) | **9** | |
| 5.1 | Natural radioactivity, decay constant (Derivation not expected), half life, average life | 1 | 11 |
| 5.2 | Disintegration series, modes of decay-α,β, positron emission and electron capture, artificial transmutation and artificial radioactivity | 1 | 11 |
| 5.3 | Nuclear stability, n/p ratio,modes of decay- α, β and positron emission, packing fraction, mass defect and binding energy | 1 | 11 |

| | | | |
|---|---|---|---|
| 5.4 | Units of radio activity, Measurement of radioactivity by GM counter, Wilson cloud Chamber, scintillation counter, | 1 | 12 |
| 5.5 | Nuclear fission-atom bomb and nuclear fusion- hydrogen bomb- | 1 | 13 |
| 5.6 | Applications of radioactivity- $^{14}C$ dating, rock dating, neutron activation analysis<br>Isotope as tracers, dosimetry, units<br>Study of reaction mechanism (ester hydrolysis) | 2 | 13 |
| 5.7 | Application of radioactive isotope in medicine- radio diagnosis and radiotherapy, industrial applications | 1 | 13 |
| 5.8 | Merits and demerits of nuclear technology. | 1 | 13 |
| **6** | **Chemistry of Nano materials** | **9** | |
| 6.1 | Evolution of nanoscience- Historical aspects, preparations containing nano gold in traditional medicine. Lycurgus cup-Faraday's divided metal etc. Nanosystems in nature. | 2 | 14 |
| 6.2 | Preparations of nanoparticles: Top-down approaches and Bottom to top approaches. Sol- gel synthesis, colloidal precipitation, co-precipitation, combustion techniques, sonochemistry, hydrothermal technique, high energy ball milling etc. | 3 | 13 |
| 6.3 | Carbon nanotubes , fullerens. | 1 | 14 |
| 6.4 | Properties of nanoparticles: optical, magnetic, mechanical, thermal and catalytic property with examples. | 2 | 15 |
| 6.5 | Application nano materials- Nano sensors and Quantum dots(basic idea) | 1 | 13 |

**Text books**

1. M C Day and Selbin, "Theoretical Inorganic Chemistry",
2. F A Cotton, G Wilkinson ,"Basic Inorganic Chemistry", Wiley
3. J D Lee, "Concise Inorganic Chemistry ,.ELBS
4. Puri ,Sharma and Kalia, Inorganic Chemistry, Vishal Pub.lishing House
5. T Pradeep, Nano, The Essentials, Mc Graw Hill Education

**For Further Reading**

1. S Glasston,"Source Book on Atomoc Energy", East West Press Pvt. Ltd, New Delhi
2. J E Huheey Inorganic Chemistry, Principles, structure and Reactivity, by
3. H S Arnicker,"Essentials Nuclear Chemistry", New Age international (P)Ltd, New Delhi
4.Manas Chanda, " Atomic Structure and Chemical bonding in Molecular Spectroscopy",Tata Mc Graw Hill

**UNIVERSITY OF KRALA**
**Model Question Paper of B.Sc. Chemistry Programme**
**2020 admissions onwards**
**SEMESTER -III Core Course-II Course Code – CH1341 Credit-3**

**INORGANIC CHEMISTRY II**

**Time: 3 Hours** **Maximum Marks: 80**

## SECTION A

(Answer **all** questions. Each question carries **1** mark)

1. Calculate the bond order of $O_2^+$
2. $C_{60}$ is called ----------
3. What are nano sensors?
4. Name the type of hydrogen bonding in salicylaldehyde.
5. Draw the structure of inorganic benzene.
6. Write an example for inter halogen compound.
7. Give an example for phosphorus based polymer.
8. Name a naturally occurring radioactive isotope.
9. Write an example of carboranes?
10. What is zeolite?

## SECTION B

(Answer any **8** questions. Each question carries **2** Marks)

11. Compare the properties of borazole with benzene.
12. Explain one method of preparation of gold nano particles.
13. Enumerate the applications of nano particles in medicine and electronics
14. Write a note on Fajan's rule.
15. Calculate the bond order of $N_2$ and $C_2$.
16. What are the limitations of VBT?
17. Explain the 'banana bond' in diborane.
18. Define lattice energy?
19. Differentiate between Rad and Roentgen units.
20. What is the criterion of a stable nucleus?
21. Write a note pseudo halogens.
22. Give a suitable example of dipole-dipole interaction

## SECTION C

(Answer any **6** questions. Each question carries **4** Marks)

23. Draw the MO diagram for NO and CO molecule
24. Give a comparative account of VB and MO theories using relevant examples.
25. What is meant by dipole moment? How is it helpful in explaining the structure of molecules?
26. Write a note on the preparation of nano particles using sol-gel method.
27. Explain the optical, magnetic properties of nanoparticles with examples.

28. Write the hybridisation and structures of Xenon fluorides.
29. Explain artificial transmutation with an example.
30. How is mass defect related to Nuclear binding energy?
31. Write a note on the manufacture of glasses.

## SECTION D

(Answer any **2** questions. Each question carries **15** Marks)

32. (a) Explain VSEPR theory with example (5 marks)

(b) Write a note on

i) solvation energy and solubility of ionic solids (5 marks)

ii) secondary bond forces (5 marks)

33.(a) Explain the measurement of radio activity by

i) GM counter (5 marks)

ii) Scintillation counter (5 marks)

(b) Write a note on radio carbon dating. (5 marks)

34. (a) Write a note on disintegration series. ( 6 marks)

(b) Explain the structure of silicates. ( 5 marks)

c) Give an account of oxy acids of phosphorus ( 4 marks)

35. (a) Write a note on carbon nanotubes and fullerenes (6 marks)

(b) Radio active carbon in wood decay with a half life of 5770 years.

What is the rate constant ( in year$^{-1}$) for the decay?

What fraction would remain after 11540 years? (4 marks)

(c) Give an account of band theory (6 marks)

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**

**2020 Admission onwards**

| | |
|---|---|
| Semester | IV |
| Course | Core course-III |
| Course name | **ORGANIC CHEMISTRY – I** |
| Course Code | CH 1441 |
| Credit | 3 |
| Hours | 54 hours |
| Lecture-Tutorial-Lab | **3-0-2** |

| CO No. | **COURSE OUTCOME**<br>*Upon completion of this course, the students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Recall the fundamentals of organic chemistry. | R | PSO1 |
| 2 | Apply the electron displacement effects to compare acidity, basicity and stability of organic compounds/intermediates. | A | PSO4 |
| 3 | Judge the reaction mechanism of substitution and elimination on the basis of the structure of alkyl halides. | U | PSO10 |
| 4 | Summarise the chemistry of reaction intermediates. | U | PSO10 |
| 5 | Discuss optical, geometrical and conformational isomerism of organic compounds. | U | PSO11 |
| 6 | Use CIP rules to predict the configuration of organic compounds | A | PSO10 |
| 7 | Differentiate photochemical and thermal reactions. | U | PSO11 |
| 8 | Discuss theory of colour and constitution and the method of synthesis of dyes | U | PSO8 |
| 9 | Explain aromaticity, orientation effect and mechanism of aromatic electrophilic substitution. | U | PSO10 |
| 10 | Demonstrate the method of determination of reaction mechanism. | A | PSO10 |

**R-Remember, U-Understand, A-Apply**

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **1** | **Introduction to organic chemistry** | **3** | |
| 1.1 | Uniqueness of carbon: classification of organic compounds, Functional groups (mention only), Review of basic rules of IUPAC nomenclature and IUPAC naming of organic compounds. | 1 | 1 |
| 1.2 | Types of reagents: Electrophiles and Nucleophiles.<br>Definition of reaction mechanism.<br>Drawing of electron movements with arrows: curved arrow notation, Half headed and double headed arrows. | 2 | 1 |

| | | | |
|---|---|---|---|
| | Nature of bond fissions: Homolysis and heterolysis. | | |
| **2** | **Reaction mechanism I** | **9** | |
| 2.1 | Electron displacement effects: Inductive effect, electromeric effect, mesomeric effect, resonance, hyperconjugative and steric effects. | 2 | 2 |
| 2.2 | Acidity and basicity of organic compounds based on electron displacement effects: Acid characters of alcohols, phenols (phenol, o/m/p-cresols and o/m/p-nitro phenols) and carboxylic acids (aliphatic acids, mono, di, tri chloro acetic acids, Benzoic acid, o/m/p-nitro benzoic acids) and basic character of amines (aliphatic amines, aniline, N- & N,N-dimethyl aniline, o/m/p-nitro anilines ando/m/p- toluedienes) | 2 | 2 |
| 2.3 | Effects of hyperconjugative effect: stability of alkenes, alkylbenzenes, free radicals and carbocations. Dipole moment of propene and toluene. | 1 | 2 |
| 2.4 | Reaction intermediates: Carbocations, carbanions, free radicals and carbenes (definition, hybridization, structure, classification, formation, stability and important reactions), rearrangement of carbocations nitrenes(mention only). | 2 | 2/4 |
| 2.5 | Methods of determination of reaction mechanism: product analysis, intermediates, isotopic labeling (only benzyne mechanism), kinetic and stereo chemical evidences (Walden inversion). | 2 | 10 |
| **3** | **Reaction Mechanism II** | **9** | |
| 3.1 | Aliphatic nucleophilic substitutions: mechanism of SN1 and SN2 reactions, Effect of nature of substrate and solvent in substitution reactions , Stereochemistry of SN reactions ,Stereospecificity and Stereoselecticity in SN reactions , Walden Inversion.<br>Neighbouring group participation (anchimeric assistance): Participation of lone pair of electrons in substitution reaction, mechanism of base catalysed hydrolysis of mustard gas only. | 3 | 3 |
| 3.2 | Elimination reaction: 1,1 and 1,2 eliminations, mechanisms of E1 and E2 reactions, Regioselectivity in elimination reactions (Hoffmann and Saytzeff rule and Bredt's rule).<br>Stereo chemical pathways of elimination: Syn and Anti eliminations.<br>Substitution vs Elimination. | 3 | 3 |
| 3.3 | Addition reactions: mechanism of addition of bromine and hydrogen halides to double bonds6y, Regioselectivity in addition reaction (Markownikoff's rule and peroxide effect). Cis-hydroxylation, Diels Alder addition, 1,2- and 1,4- additions in 1,3-butadiene. | 3 | 3 |
| **4** | **Stereochemistry I** | **6** | |
| 4.1 | Representation of organic molecules: Fischer, Flying wedge, Sawhorse and Newman projection formulae. | 1 | 5 |
| 4.2 | Conformational isomerism : conformation , Dihedral angle , Torsional strain , conformational analysis of ethane and n-butane including energy diagrams | 2 | 5 |
| 4.3 | Baeyer's strain theory , Sache-Mohr theory of strainless rings, Pitzer strain | 1 | 5 |
| 4.4 | Conformation of cyclohexane (chair, boat and skew boat | 2 | 5 |

| | | | |
|---|---|---|---|
| | forms),axial and equatorial bonds ,ring flipping,conformers of mono and dialkyl substituted cyclohexanes. | | |
| **5** | **Stereochemistry II** | **9** | |
| 5.1 | Optical Isomerism: Chirality and elements of symmetry, DL notation, Enantiomers<br>Optical isomerism in glyceraldehydes, lactic acid and tartaric acid Diastereoisomers, meso compounds | 2 | 6 |
| 5.2 | Cahn-Ingold-Prelog rules, R-S notations for optical isomers with one and two asymmetric carbon atoms, erythro and threo representations. Racemic mixture, resolution, methods of resolution. | 2 | 5/6 |
| 5.3 | Enantiomeric excess , Introduction to asymmetric synthesis<br>Optical activity in compounds not containing symmetric carbon atoms: biphenyls and allenes. | 2 | 6 |
| 5.4 | Geometrical isomerism: cis-trans, syn-anti and E-Z notations , geometrical isomerism in maleic and fumaric acids and unsymmetrical ketoximes , methods of distinguishing geometrical isomers using melting point, dipole moment, dehydration and cyclisation | 3 | 6 |
| **6** | **Organic Photochemical Reactions and Dyes** | **9** | |
| 6.1 | Introduction – photochemical Vs thermal reactions.<br>Single and Triplet states b , Allowed and forbidden transition.<br>Photosensitization | 1 | 7 |
| 6.2 | Photochemical reactions of olefins: Photodimerisation<br>Photochemistry of carbonyl compounds: Norrish I (Acetone), Norrish II cleavages. | 2 | 7 |
| 6.3 | Introduction to pericyclic reaction: Electrocyclic, cycloaddition and sigmatropic reactions.(Elementary idea only) | 2 | 7 |
| 6.4 | Dyes: Theory of colour and constitution , classification according to structure and method of application.<br>Preparation and uses of 1) Azo dye - methyl orange, congored, 2) Triphenyl methane dye - malachite green, 3) Phthalein dye - phenolphthalein, 4) Xanthen dye - fluorescein, 5) Anthraquinone dye - alizarin 6) Vat dye - indigo.<br>Optical brightners – Introduction and important characteristics. | 4 | 8 |
| **7** | **Arenes and Aromaticity** | **9** | |
| 7.1 | Heat of hydrogenation and heat of combustion of benzene, structure of benzene , Concept of aromaticity – Application of Huckel's rule to benzenoid and nonbenzenoid compounds (naphathalene, anthracene, annulenes, cyclic carbocations and anions, five membered heterocylics, azulene, fulvene) | 3 | 9 |
| 7.2 | Electrophilic substitution reactions in benzene: Mechanism of halogenation, nitration, sulphonation and Friedel Craft's alkylation and acylation, energy profile diagram. | 2 | 9 |
| 7.3 | Ring activating and deactivating groups with examples.<br>Orientation effect in mono substituted benzene - –OH, -NH2, NO2, -CH3, -CHO, COOH and halogens. | 2 | 9 |
| 7.4 | Aromatic nucleophilic substitution – Uni and bimolecular displacement mechanism , Elimination and Addition mechanisms | 1 | 9 |
| 7.5 | Reactivity of naphthalene towards alkylation, nitration and sulphonation. Basic idea of carcinogenic polynuclear arenes. | 1 | 9 |

**Text books:**


1. A.Bahl and B.S.Bahl, Advanced Organic Chemistry, S.Chand & Company, New Delhi.
2. L.G.Wade Jr, Organic Chemistry, Pearson Education, New Delhi.
3. K.S.Tewari, N.K.Vishnoi and S.N.Mehrotra, A textbook of Organic Chemisty, Vikas Publishing House (Pvt) Ltd., New Delhi..
4. S.C.Sharma and M.K.Jain, Modern Organic Chemistry, Vishal Publishing Company, New Delhi.
5. D.Nasipuri, Stereochemistry of Organic Compounds: Principles and Applications, New Age International Publizhers, New Delhi.
6. J.Clayden, N.Greeves and S.Warren, Organic Chemistry, Oxford University Press, New York.
7. I L Finar, "Organic Chemistry" Vol – 1, 5th Edition, Pearson Education, NewDelhi
8. Jagadamba Singh and Jaya Singh, Photochemistry and Pericyclic rections, New Age International, New Delhi.


**For Further Reading**


1. P.S.Kalsi, Organic Reactions, Stereochemistry, and Mechanism, New Age International Publishers, New Delhi
2. R.T.Morrison, R.N.Boyd. Organic Chemistry, Pearson Education, New Delhi.
3. P.Y.Bruice, Essential Organic Chemisty, Pearson Education, New Delhi.
4. Peter Sykes, A Guide Book to Mechanism in Organic Chemistry, Pearson Education, New Delhi.
5. G.M. Louden, Organic Chemistry, Oxford University Press, New York.
6. E.L.Eliel, Stereochemistry of Carbon compounds, Tata McGraw Hill Publishing House, New Delhi.
7. J.March, Advanced Organic Chemistry, John Wiley & Sons., NY.
8. S.M.Mukerji and S.P.Singh, Reaction Mechanism in Organic Chemistry, McMillan Publishers.
9. R.O.C. Norman and J.M.Coxon, Principles of Organic Synthesis, CRC Press.


**UNIVERSITY OF KERALA**

**Model Question Paper of BSc Chemistry Programme**

**2020 Admission onwards**

**SEMESTER IV Core Course III Course Code CH1441 Credit-3**

**ORGANIC CHEMISTRY I**

Time:3 hours Max.Marks : 80

SECTION – A

*(Answer **all** questions. Answer in **one** word to maximum **two** sentences. **Each** question carries **one** mark)*

1. What is the product formed when a bond undergoes homolytic fission?
2. Give one example for each (i) substitution reaction and (ii) elimination reaction.
3. Write an example for electrocyclic reaction.
4. Name two reagents used for cis-hydroxylation.
5. What are the products obtained when naphthalene undergoes sulphonation at different temperatures?
6. Identify the orienting effect of the following functional groups $–CH_3$, $-NO_2$, -CHO and –OH.
7. What are chromophores?
8. What is stereo selectivity?
9. What is geometrical isomerism?
10. What are optical brightners?

**(1 X 10 =10 Marks)**

SECTION - B

(*Short answer type. Answer **any 8** questions from the following. **Each** question carries **two** marks.)*

11. What are electrophiles and nucleophiles? Give examples
12. Write the structure of the following compounds (i) 3,3,4-trimethyl-4-heptene (ii) 2-ethyl-3-methyl hexanal.
13. Phenol is acidic while ethanol is not. Why?
14. Arrange the following in the decreasing order of stability. Justify your answer.
$(CH_3)_2CH^+$, $CH_3^+$, $(C_6H_5)_2CH^+$, $C_6H_5CH_2^+$
15. Give an example and state Hofmann rule.
16. What is Walden Inversion?
17. What is Kharasch effect? Illustrate with an example.
18. When toluene is nitrated the major products are ortho and para substituted products. Why?
19. State Huckel's rule.
20. Explain photosensitization with an example.
21. What is enantiomeric excess?
22. Explain with examples the importance of dipole moment measurements in distinguishing geometrical isomerism.

**(2 X 8 = 16 Marks)**

**SECTION - C**

**(*Short essay type. Answer any 6 questions from the following. Each question carries four marks.)***

23. What is inductive effect? How is it affect the acidity and basicity of organic acids and bases?
24. Explain the mechanism of E1 and E2 eliminations.
25. *o*-chloro toluene when treated with sodamide in liquid ammonia gives *o*-toluidine and *m*-toluidine. Explain this observation with relevant mechanism.
26. Explain Norrish I and Norrish II reactions.
27. Determine the R & S notations of the asymmetric carbon atoms in (+) tartaric and (-) tartaric acid
28. Explain the conformational analysis of *n*-butane.
29. Give a brief account on optical activity due to restricted rotation.
30. Explain any two methods of determination of reaction mechanism.

31. What are non-benzenoid aromatics compounds? Explain their aromaticity with examples

**(4 X 6 =24marks)**

## SECTION – D

(*Answer **any2** question. Each question carries 15 marks*)

32. (a) Explain $S_N1$ and $S_N2$ mechanisms.
    (b)Write the influence of structure of the substrate and polarity of the solvent on nucleophilic substitution reactions.
    (c) Explain Baeyer's strain theory. (5+5+5)

33. (a) Explain the mechanism of (i) nitration (ii) halogenation of benzene.
    (b) Discuss the orientation of influence of $–NO_2$ and –OH group in aromatic electrophilic substitution.
    (c) Discuss the classification of dyes on the basis of structure.
    (5+5+5)

34. (a) What is resolution? Explain any two methods of resolution.
    (b) What are carbenes? How are they generated? Comment on the structure of carbene.
    (c) Draw conformers of dimethyl cyclohexane and discuss their comparative stability.
    (5+6+4)

35. (a) Write the synthesis and uses of the following dyes (i) Malachite green (ii) Methyl Orange.
    (b) Explain the geometrical isomerism of maleic and fumaric acid.
    (c) What is hyperconjugative effect? How is it useful to explain the stability of carbonium ions?

    (6+4+5)

**(15 X 2 = 30marks)**

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**

**2020 Admission onwards**

| | |
|---|---|
| Semester | V |
| Course | Core Course V |
| Course name | **PHYSICAL CHEMISTRY I** |
| Course Code | CH 1541 |
| Credit | 4 |
| Hours | 54 hours |
| Lecture | 3-0-2 |

| CO No. | **COURSE OUTCOME**<br>*Upon completion of this course, the students* | Cognitive level | PSO |
|---|---|---|---|
| 1 | Identify, compare and explain the properties and behaviourof ideal and real gases, knowing kinetic theory of gases and different types of molecular velocities and collision properties. | U | PSO11 |
| 2 | Perform numerical problems of gases under a set of conditions | A | PSO2 |
| 3 | Differentiate between amorphous and crystalline solids, Understandanisotropy, symmetry and types of crystals, X-ray diffraction methods of study of crystal structure, identify the imperfections in crystals<br>understand the physical aspects of surface tension and viscosity of liquids and the basics of liquid crystals and their applications | U | PSO11 |
| 4 | representation of lattice planes and calculation of interplanar spacing, draw the crystal structures of NaCl and CsCl | A | PSO9 |
| 5 | Recalling the basic concepts of solutions, concentration terms, Raoult's law and colligative properties | U | PSO9 |
| 6 | Determination of colligative properties and molecular mass of solute | E | PSO9 |
| 7 | Understand the working principle Electro-Chemical cells | U | PSO9 |
| 8 | Design and Determine the potentials ofelectrochemical systems | E | PSO2 |
| 9 | Assess the nature of electrolytes in terms of dissociation and ionic conductance of electrolytes in terms of mobility of ions | E | PSO2 |
| 10 | Integrate the theory into practical applications of conductometric titrations | A | PSO3 |

| **MODULE** | **COURSE DESCRIPTION** | **Hrs** | CO No. |
|---|---|---|---|
| **1** | **Gaseous state** | **9** | |
| 1.1 | Ideal gas, Ideal gas equation, gas constant: values in different units ($JK^{-1}mol^{-1}$, L atm $K^{-1}mol^{-1}$, cal $K^{-1}mol^{-1}$.), Dalton' Law of Partial pressure- Definition and mathematical expression. | 1 | 1 |
| 1.2 | Kinetic Theory of gases: postulates,Types of molecular velocities (average, most probable and RMS), formulas and their inter relations. Maxwell Boltzmann distribution of molecular velocities (with plots), Effect of temperature on distribution of molecular velocities | 2 | 1/ 2 |
| 1.3 | Collision properties. Collision diameter, Collision number, Collision frequency and mean free path. Relation between collision parameters and viscosity and thermal conductivity of gases (no derivation). | 1 | 1/ 2 |

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| 1.4 | Behaviour of real gases, Deviation from ideal behaviour, Explanation for deviation, Compressibility factor, Z-P plots of ideal gas and the real gases $H_2$, He, $NH_3$, CO and methane at 0°C, Z-P plots of $N_2$ at several temperatures. van der Waal's equation of state – Correction factors. van der Waal's equation at low and high pressures and at high temperature. | 2 | 1/ 2 |
| 1.5 | Boyle temperature, Boyle temperature in terms of van der waal's constant. Virial equation of state and virial coefficients. (no derivations) | 1 | 2 |
| 1.6 | Critical phenomena: PV-Isotherms of $CO_2$, continuity of states, critical point, Critical constants, relation between critical constants and van der Waals constants, Experimental determination critical constants. | 2 | 2 |
| **2** | **Solids, Liquids and Liquid Crystals** | **12** | |
| 2.1 | Amorphous and Crystalline solids. Isotropy and anisotropy, size and shape of crystal, Interfacial angle, types of crystals: molecular crystals, ionic crystals, covalent crystals and metallic crystals- examples and properties. | 1 | 3 |
| 2.2 | Symmetry of crystals- plane of symmetry, axis of symmetry, centre of symmetry (definitions and basic idea only), Seven basic crystal systems, Space lattice and unit cell, Bravais lattices, (unit cell parameters and examples of 14 Bravis lattices), close packing structures of cubic and orthorhombic space lattices. | 2 | 3 |
| 2.3 | Laws of rational indices, Miller indices, Representation of lattice planes of cubic crystals, interplanar spacing in crystals<br>Determination of Avogadro number from crystallographic data | 2 | 4 |
| 2.4 | X-ray diffraction studies of crystals, Bragg's equation – derivation and applications, Rotating crystal and powder method.<br>Structure of NaCl and CsCl | 2 | 4 |
| 2.5 | Imperfections in crystals. Stoichiometric and Non-stoichiometric defects, point defects – Schottky and Frenkel defects, F-centre | 1 | 3 |
| 2.6 | **liquid state** : Properties of liquids: Vapour pressure-definition and concept, Surface tension-factors affecting Surface tension and measurement by capillary rise and stalagmometer method | 1 | 3/ 4 |
| 2.7 | Viscosity- Poisuelle's equation, Determination of viscosity by Ostwald's viscometer, Refractive index-determination by Abbe refractometer | 1 | 4 |
| 2.8 | **Liquid Crystals :**<br>Liquid crystals- introduction, characterization of liquid crystals, Types –smectic, nematic and cholesteric liquid crystals,- examples; Disc shaped liquid crystals, Polymer | 2 | 3 |

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|---|---|---|---|
| | liquid crystals. uses of liquid crystals | | |
| **3** | **Dilute solutions and colligative properties** | **9** | |
| 3.1 | Dilute solutions: Binary solutions, Concentration- Molarity, Molality, Normality and Mole fraction. (numerical problems) | 2 | 5 |
| **3.2** | Raoult's Law for solutions of non-volatile solutes, vapour pressure of ideal solutions and relative lowering of vapour pressure. | 1 | 5 |
| **3.3** | Colligative properties- lowering of vapour pressure; elevation of boiling point and depression in freezing point; molal elevation constant, molal depression constant, Thermodynamic derivation of $\Delta T$; Osmosis and Osmotic pressure, van't Hoff equation; Isotonic, hypertonic and hypotonic solutions, Abnormal molecular mass and van't Hoff factor, Determination of degree of dissociation and association, Reverse osmosis (numerical problems). | 4 | 5/ 6 |
| **3.4** | Experimental determination of molecular mass of solutes by cooling curve method,Rast's and Beckmann methods | 2 | 6 |
| **4** | **Electrolytic conductance** | **12** | |
| 4.1 | Electrolytic conductance, specific and equivalent conductance and the relation between them. Molar conductance and its variation with dilution, Kohlraush's law and its applications , cell constant | 2 | 7 |
| 4.2 | Ionic mobility, transport number- determination by Hittorf's and moving boundary method | 2 | 7 |
| 4.3 | Applications of conductivity measurements:- Determination of degree of dissociation of weak electrolytes, degree of hydrolysis, solubility of sparingly soluble salts, conductometric titrations involving strong acid<br>strong base, strong acid-weak base, weak acid- strong base, weak acid-weak base and precipitation. | 2 | 7, 10 |
| 4.4 | Debye-Huckel theory of strong electrolytes, Debye-Huckel-Onsager equation, Debye-Falkenhagen effect, Wien effect | 2 | 7 |
| 4.5 | Activity and activity coefficient of electrolytes, Ionic strength | 2 | 7 |
| **5** | **Electromotive force** | 2 | 8 |
| 5.1 | Electrochemical cells- definition, types- electrolytic and galvanic with examples ( Daniel cell and electrolysis of Cu), Origin of electrode potential, half cell reaction and | **12** | 9 |

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|---|---|---|---|
| | cell reactions. | | |
| 5.2 | Types of electrodes-Metallic electrodes, anion reversible electrodes and redox electrodes, Reference electrodes-standard hydrogen electrode, calomel electrode and | 2 | 9 |
| 5.3 | Effect of concentration of electrolytes on electrode potential: Nernst equation for electrode and cell (Derivation), Numerical problems | 2 | 10 |
| 5.4 | Relation between electrical energy, free energy, enthalpy and entropy- Gibb's Helmholtz equation and EMF of a cell -calculation of $\Delta G$, $\Delta H$ and $\Delta S$ from EMF data. | 3 | 9 |
| 5.5 | Concentration cells - electrode and electrolyte concentration cells,examples, with and without transference (no derivation),fuel cells –H2-O2 and hydrocarbon-O2 | 3 | 9 |
| 5.6 | Applications of EMF measurements- Determination of pH using hydrogen electrode and potentiometric titrations of redox systems with Fe/Cr system | 2 | 8,10 |

(At least 100 problems are to be worked out from all units together. 30% of the questions for Examination shall contain problems.)

**Textbooks**


1. Gurdeep Raj, "Advanced Physical Chemistry", Goel Publishing House
2.P W Atkins, "Physical Chemistry", Oxford University Press
3. Anthony R West, " Solid State Chemistry and its Applications", Wiley Eastern
4. V Ramakrishnan and M S Gopinathan, "Group Theory in Chemistry",Vishal Publishing Co.

5.Puri, Sharma and Pathania, "Principles of Physical Chemistry", Millennium Edition, Vishal Publishing Co


**For Further Reading**


1 A. Salahuddin Kunju and G. Krishnan "Group Theory and its Applications in Chemistry
2. R J Silby and R A Alberty, "Physical Chemistry", John Wiley & Sons
3. G W Castellan, "Physical Chemistry", Narosa Publishing House
4. F Daniels and R A Alberty, "Physical Chemistry", Wiley Eastern
5. E A Moelwyn Hughes, " Physical Chemistry", Pergamon Press
6.R.Stephen Berry,Stuart A.Rice,John Ross,"Physical Chemistry,2nd edition,Oxford".
7. S Glasstone, "Thermodynamics for Chemists", Affiliated East West Publishers
8.L V Azaroff, " Introduction to Solids", McGraw Hill
9. N B Hannay, " Solid State Chemistry", Prentice Hall
10. A.S.Negi and S.C.Anand, A text book of Physical Chemistry, New Age International publishers.

**UNIVERSITY OF KERALA**

**Model Question Paper of B.Sc. Chemistry Programme**

**2020 Admissions onwards**

**SEMESTER- V Core Course- V Course Code 1541 Credit-4**

**PHYSICAL CHEMISTRY –I**

Time: 3 Hrs Total marks: 80

## SECTION A

**Answer all the questions. Each question carries 1 mark**

1. Write down the van der Waal's equation for n moles of a gas.
2. Write down the conditions at which real gases tend to approach ideal behaviour
3. Explain the Braggs equation
4. Depict the structure of CsCl.
5. Identify the use of Stalagmomter.
6 Represent the cell diagram of Daniel cell
7. Name a primary reference electrode.
8. In which type of liquid crystals, the colour of the material is sensitive to temperature changes
9. How will you express the degree of dissociation in a weak electrolyte?
10. Explain the Gibb's Helmholtz equation for the emf of a cell.

(1 x 10 = 10 marks)

## SECTION B

Each question carries 2 marks (Short answer). Answer any **8** questions

11. Distinguish between RMS and most probable velocity.
12. Distinguish between isotropy and anisotropy.
13. Calculate the Miller index of of a plane with x=1,y=1/2 and z=1.
14. Explain elements of symmetry of crystals
15. Comment on the statement that Depression in freezing point is a colligative property.
16. Calculate the normality of a solution containing 10 gram NaOH in 250 mL of NaOH solution.
17. How is the EMF generated in a concentration cell? Explain..
18. How will you carry out potentiometric titration of HCl and NaOH?
19. Derive the Nernst equation for the reduction of $Cu^{2+}$ to Cu.
20. Define Kohlraush's law
21. Name a common anion reversible electrode and give its reduction half cell representation
22. Define transport number. Suggest one method for its determination.

**(2×8 = 16)**

## SECTION C

Each question carry 4 marks (Short essay) **Answer any 6 questions**

23.What is the law of corresponding states? How is it derived from van der Waals equation

24. Derive the Bragg equation. What is its application?

25.The average speed of a certain gas at 27$^{o}$C is 400ms$^{-1}$. Calculate the temperature at which the speed will be 800ms$^{-1}$.

26. How will you determine Avogadro number from crystallographic data?.

27. Write a note on the different types of Liquid crystals

28. Discuss on cubic and hexagonal close packing in crystals. Give example for each.

29. Differentiate between molecular and covalent crystals.

30. Calculate the wave length of X rays used for a first order reflection in NaCl crystal. The inter planar spacing is 0.281nm for this reflection.

31. Derive an expression for pH measurement using Hydrogen electrode.

**(4 x 6 = 24 marks)**

## SECTION D

**Answer any two questions**. Each question carries 15 marks

32. a)Do all gases obey gas laws? Discuss some experimental results to explain deviation and point out the causes which accounts for this behaviour
(5 marks)

b) Explain with diagrams the influence of temperature on molecular velocities in gases.
(5marks)

c) Write a note on continuity of states and critical points.
(5marks)

33. a) Derive Bragg's equation. (5 marks)

b) The edge length of the unit cell of NaCl crystal lattice is 564 pm by X-ray diffraction. Compute the interionic distance between sodium and chloride ions. (5 marks)

c) Give an account of point defects in a crystal. (5 marks)

34. a) An aqueous solution containing 0.50 g of a solute, dissolved in20 g of water froze at 272.58K. Calculate the molar mass of the solute. Enthalpy of fusion of ice, at 273K is 6024.6 J/mol. (5 marks)

b) b)Briefly discuss on the determination of viscosity of liquids. (5 marks)

c) (Explain with necessary diagrams the conductometric titrations of acids and bases. ( 5 marks)

35. a). Calculate the following

i) the free energy change for the cell , $Zn/Zn^{2+}// Cu^{2+}/Cu$ with an EMF of 1.1 volt at $25^0C$.

ii) the electrode potential of $Cu^{2+}/Cu$ in the above cell if the electrode potential of $Zn/Zn^{2+}$ is 0.76 volt.

(5marks )

b) How will you construct a concentration cell using Zn metal electrode and zinc sulphate solution? (5 marks)

c) Give an account of Standard hydrogen electrode and Calomel electrode. (5 marks)

**(15x2=30)**

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**

**2020 Admission onwards**

| | |
|---|---|
| Semester | V |
| Course | Core course-VI |
| Course name | **INORGANIC CHEMISTRY III** |
| Course Code | CH 1542 |
| Credit | 4 |
| Hours | 72 hours |
| Lecture-Tutorial-Lab | 4-0-3 |

| CO No. | **COURSE OUTCOME** *Upon completion of this course, the students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Discuss the electronic configuration and related properties of transition elements and inner transition elements | U | PSO11 |
| 2 | Understand preparation of selected transition metal compounds,lanthanides and actinides | U,A | PSO11 |

| | | | |
|---|---|---|---|
| 3 | Compare lanthanide and actinide contraction and their consequences. | U | PSO11 |
| 4. | Name coordination complexes,organometallics, discuss their properties and bonding | U | PSO11 |
| 5 | Understand stability of complexes and factors affecting stability | U | PSO3 |
| 6 | Discribe isomerism in coordination compounds | U, A | PSO3 |
| 7 | Discuss spectrochemical series, CFSE and their consequences | U | PSO3 |
| 8 | Correlate geometry , stability and Jahn Teller effect and its causes | A | PSO11 |
| 9 | Discuss reaction mechanisms and applications of coordination compounds | U | PSO11 |
| 10 | Name and Classify organometallic compounds | U | PSO3 |
| 11 | Discuss preparation and properties and bonding of carbonyls | U | PSO3 |
| 12 | Identify the role of organometallic compounds in organic synthesis | U | PSO10 |
| 13 | Discuss the role of inorganic ions in biological systems and biochemistry of haemoglobin, myoglobin, cytochromes, iron sulphur proteins | U | PSO10 |
| 14 | Discuss various bioinorganic processes like photosynthesis, working of sodium potassium pump, etc | U | PSO17 |
| 15 | Discribe various aspects of metallurgy,and instrumental methods of analyses viz., spectrophotometric methods, thermal methods and tools available to measure nanomaterials | U | PSO6 |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **1** | **Transition elements and Inner transition elements-I** | **9** | |
| 1.1 | Electronic configuration and general characterisitics- Oxidation state, Ionization enthalpy (variation of I,II and III ionization enthalpy across 3d series) and Enthalpy of atomisation | 2 | 1 |
| 1.2 | Melting and boiling point, density and Variation of std. electrode potentials ($E^o$ $M^{2+}/M$ & $E^o$ $M^{3+}/M^{2+}$) | 2 | 2 |
| 1.3 | Stability of higher oxidation states and formation of complexes | 1 | 2 |
| 1.4 | Colour, magnetic property and catalytic property | 1 | 2 |
| 1.5 | Comparison of 3d, 4d and 5d transition series | 1 | 3 |
| 1.6 | Preparation, properties and uses of $K_2Cr_2O_7$ , $KMnO_4$ and $TiCl_4$. Important application of transition metals | 2 | 4,5 |

| | | | |
|---|---|---|---|
| **2** | **Transition elements and Inner transition elements-II** | **9** | |
| 2.1 | Electronic configuration, general properties (including oxidation state, I.E., melting and boiling points, density, ionic radii, colour, etc) and reactions of Lanthanides and actinides | 3 | 6 |
| 2.2 | Occurrence and isolation of lanthanides from monazite(Special reference to mineral sands of Kerala) | 2 | 7 |
| 2.3 | Lanthanide contraction, actinide contraction and their consequences | 2 | 8 |
| 2.4 | Magnetic properties and complexation behaviour of lanthanides and actinides (with comparison) | 2 | 8 |
| **3** | **Coordination chemistry-I** | **9** | |
| 3.1 | Ligands and their classifications and nomenclature of complexes (latest version) | 2 | 9 |
| 3.2 | EAN rule – Chelates – Stability of complexes and Factors affecting stability of complexes | 1 | 10 |
| 3.3 | Isomerism – Structural and stereoisomerism – Geometrical and optical isomerism | 2 | 11 |
| 3.4 | Bonding in complexes – V.B. Theory, CFT applied to Octahedral, Tetradral and square pyramidal complexes. factors affecting crystal field | 4 | 12 |
| **4** | **Coordination chemistry –II** | **9** | |
| 4.1 | Spectrochemical series – CFSE, Magnetic properties and colour of metal complexes . | 3 | 13 |
| 4.2 | Effects of crystal field splitting –Jahn -Teller effect- Tetragonal distortion of an octahedral complex | 3 | 14 |
| 4.3 | Application of coordination compounds in metallurgy, volumetric - quantitative and qualitative analysis. EDTA as a titrant. | 2 | 15 |
| 4.4 | Reactions of metal complexes-labile &inert complexes, ligand substitution reactions- SN1 & SN2 reactions | 1 | 16 |
| **5** | **Organometallic and Bioinorganic chemistry-I** | **9** | |
| 5.1 | Definition and nomenclature of organometallic compounds. | 1 | 17 |
| 5.2 | Classification as Sigma, Pi and mixed (containing both Sigma and pi) complexes, 18 electron rule | 2 | 18 |
| 5.3 | Metal carbonyls- mononuclear and polynuclear (give examples with Fe, Co and Ni ) | 2 | 19 |
| 5.4 | Preparation and properties of carbonyls (Fe, Ni, Mn, Cr), Vibrational frequency of CO bond in metal carbonyls. | 2 | 19 |

| | | | |
|---|---|---|---|
| 5.5 | Bonding in organometallic compounds like ferrocene, dibenzene chromium, Ziese's salt (without MOT) and dinitrogen complexes. | 2 | 20 |
| **6** | **Organometallic and Bioinorganic chemistry-II** | **9** | |
| 6.1 | Application of organometallic compounds | 2 | 21 |
| 6.2 | Bioinorganic chemistry- Role of metal ions in biological systems- Biochemistry of iron-haemoglobin and myoglobin (elementary idea of the structure and mechanism of their actions) | 3 | 22, 23 |
| 6.3 | Electron transport proteins: Cytochromes, Iron-Sulphur proteins- storage and transport of iron. | 2 | 23 |
| 6.4 | Photosynthesis, Sodium -Potassium pump, Biochemistry of magnesium and calcium (brief study only) | 2 | 24 |
| **7** | **General Principles of Isolation of elements** | **9** | |
| 7.1 | Methods of concentration of an ore- Gravity separation, Froth floatation, Magnetic separation, Leaching, electrostatic separation, automated ore sorting and dewatering. | 2 | 25 |
| 7.2 | Preliminary processes- calcination and roasting. | 1 | 25 |
| 7.3 | Methods of extracting metal from concentrated ore- Electrometallurgy- Metallurgy of Aluminium, Sodium- Pyrometallugy- | 2 | 25 |
| 7.4 | Metallurgy of iron and zinc | 1 | 25 |
| 7.5 | Aluminothermy, auto-reduction and hydrometallurgy- metallurgy of silver and gold | 1 | 25 |
| 7.6 | Purification of crude metal- Distillation, Liquation, Zone refining, Electro refining , Chromatographic techniques and Vapour phase refining ( Mond's process and Van Arkel process) | 2 | 25 |
| **8** | **Instrumental methods of Analysis** | **9** | |
| 8.1 | Spectrophotometry- Laws of spectrophotometry- Beer Lambert's Law | 1 | 26 |
| 8.2 | Applications of spectrophotometry- colorimetry, atomic absorption spectroscopy and flame emission spectroscopy. | 3 | 26 |
| 8.3 | Thermal methods- introductory aspects of TG, DTA and DSC- Instrumentation and applications. | 2 | 27 |
| 8.4 | Tools for measuring nanostructures: XRD, AFM, STM, SEM and TEM | 3 | 28 |

**Text Books**


1. B.R.Puri, L.R,.Sharma, K.C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers
   New Delhi,2010
2. S.Prakash,G.D.Tuli, S.K Basu, R.D.Madan,Advanced Inorganic Chemistry, Vol. 1.,S Chand
3. R. Gopalan, V. Ramalingam, Concise coordination chemistry, 1st Edn., Vikas Publishing house
4. J.E.Huheey,E.A.Keiter, R.L.Keiter, O.K.Medhi. Inorganic Chemistry, 4th Edn. Pearson, 2006
5. D.A.Skoog, F.James Holler. S.R. Crouch. Principles of Instrumental analysis, 6th Edn., Cengage Learning, Noida,2004.


**For Further Reading**


1. D.A.Skoog, F.James Holler, T.A.Nieman. Principles of Instrumental analysis, 6th Edn., Cengage Learning, India Ltd.
2. A.Cottrel, An Introduction to Metallurgy, 2nd Edn. University Press, 1990.
3. D.C.Harris, Qualitatve Chemical Analysis,5th Edn., W.H. freeman & Co. New York.
4. F.A.Cotton, G. Wilkinson, Advanced Inorganic Chemistry, Wiley, India(P)Ltd


**UNIVERSITY OF KERALA**

**Model Question Paper of B.Sc. Chemistry Programme**

**2020 admissions onwards**

**SEMESTER- V Core Course- VI Course Code CH1542 Credit-4**

**INORGANIC CHEMISTRY III**

**Time: 3 Hours** **Maximum Marks : 80**

**SECTION A**

**Answer all questions, each question carries 1 mark (answer in a word\sentence)**

1. Give the general outer electronic configuration of a transition element
2. Which is more basic; $La(OH)_3$or $Lu(OH)_3$?
3. Which is the catalyst used in the oxidation of $SO_2$ to $SO_3$ in contact process?
4. Give an example for a mono nuclear and a binuclear carbonyl.
5. What is the coordination number of Ag in [Ag(CN)2] ?
6. Give the IUPAC name of Na3[Co(CO3)3]
7. What is the unit of magnetic moment?
8. Give the example for a tridentate ligand.
9. Write the structure of ferrocene.
10. Give the formula of a metal carbonyl which does not obey 18-electron rule. (1 x 10 = 10)

**SECTION B**

**Answer any 8 questions, each question carries 2 marks (short**

**answer questions)**

11.Explain zone refining.
12.Name the metal ion, other than magnesium, involved in photosynthesis.
13. Explain the stability of EDTA metal complexes.
14. How is the ore galena purified?
15. What is the oxidation number of P in $H_3PO_4$?
16. Give the importance of a cytochromes.
17. Transition metals are less reactive than the alkali and alkaline earth metals - Justify.
18. Which is more stable: $Cu^{2+}$ or $Cu^{+}$in aqueous solution. ? Substantiate your answer.
19. Which has got greater tendency to form complexes; lanthanides or actinides ? Give reasons.
20. Write the difference between calcinations and roasting
21. What is an ambidentate ligand ? Give example.
22. Explain geometrical isomerism in metal complexes with suitable example ( **2x8=16)**.

## SECTION C

**A**nswer any 6 questions, each question carries 4 marks **(short essay type)**

23.What is Ziese's salt ? Give its structure.
24. State and explain 18-electron rule with examples .
25. How haemoglobin differ from myoglobin.
26. Write notes on AAS and Flame Emission Spectroscopy.
27. Purification of crude metals by Monds proess and van Arkel processes
28. How does TGA differ from DTA?
29. What is lanthanide contraction ? Explain its consequences .
30. What are the factors that affect stability of metal complexes ?
31. Give an account of the applications of coordination compounds in quantitative and qualitative analysis.

## SECTION D

(Answer any 2 questions, Each question carries 15 marks)

32.a) Describe the ion exchange method for the separation of lanthanides from monazite. (5 marks)

b) Describe the splitting of d-orbitals in tetrahedral and octahedral fields according to crystal field theory (5 marks)

c) Comment on the magnetic properties of lanthanides (5 marks)

33.a)Give an account of Electrometallurgy and pyrometallurgy (5 marks)

b.Discuss the nature of bonding in metal carbonyls. (5marks)

c) Narrate the use of EDTA as a titrant . (5 marks)

34.a).How silicones are prepared ? Discuss their structure and uses.

b).Give an account of sodium-potassium pump in biological systems.

c)Explain the principle of zone refining with an example.

35.a)Comment on the importance of mineral sands of Kerala ?

(5marks)

b) Explain the principle and working of AFM.

(5marks)

c)Explain the crystal field splitting in octahedral field.

(5marks)

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**

**2020 Admission onwards**

| | |
|---|---|
| Semester | V |
| Course | Core course-VII |
| Course name | **ORGANIC CHEMISTRY II** |
| Course Code | CH 1543 |
| Credit | 4 |
| Hours | 72 hours |
| Lecture-Tutorial-Lab | 4-0-2 |

| CO No. | **COURSE OUTCOME**<br>*Upon completion of this course, the students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Describe the preparation of hydroxy, carbonyl & amino compounds, carboxylic acids and organo Mg, Li & Zn compounds. | R | PSO10 |
| 2 | Distinguish primary, secondary & tertiary alocohols and amines. | U | PSO10 |

| | | | |
|---|---|---|---|
| 3 | Write reaction steps in ascending & descending of alcohol and aliphatic acid series, interconversion of aldose and ketose, chain lengthening and shortening of aldoses. | U | PSO11 |
| 4. | Explain the structure of glucose, fructose, sucrose, starch and cellulose. | U | PSO11 |
| 5 | Predict the outcome and mechanism of simple organic reactions, using a basic understanding of the reactivity of functional groups | A | PSO10 |
| 6 | Illustrate the use of organic reagents in synthesis. | **A** | PSO3<br>PSO10 |
| 7 | Discuss fundamental principles of supramolecular and green chemistry | U | PSO13 |

**R-Remember, U-Understand, A-Apply**

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **1** | **Alcohols, Phenols and Ethers** | **12** | |
| 1.1 | Alcohols: Preparation- From alkenes (hydration. Hydroboration-oxidation, oxy-mercuration demercuaration) and carbonyl compounds (reduction and with Grignard reagent) | 2 | 1 |
| 1.2 | Chemical properties: Reactions involving cleavage of O-H bonds (acidity and esterification), oxidation (with PCC, Collins reagent, Jones reagent and $K_2Cr_2O_7$) and catalytic dehydrogenation | 2 | 5 |
| 1.3 | Distinction between primary, secondary and tertiary alcohols – Ascent and descent in alcohol series. Biofuel – ethanol and biodiesel. | 1 | 2 |
| 1.4 | Dihydric alcohols: Oxidative cleavage – Lead tetra acetate, periodic acid – Pinacol-pinacolone rearrangement. | 1 | 5 |
| 1.5 | Phenols: Preparation from halobenzens, cumene and sulphonic acid. Chemical properties: – Bromination, nitration, sulphonation. | 2 | 1/5 |
| 1.6 | Reimer-Tiemann reaction (mechanism expected), Kolbe reaction, Liebermann's nitroso reaction and Lederer-Mannasse reaction. Distinction between alcohols and phenols. | 2 | 5 |
| 1.7 | Ethers: Preparation by Williamson's synthesis. Reactions of ethers: Cleavage by HI and Claisen rearrangement (Mechanism expected) – Ziesel's method of estimation of methoxy group. Crown ethers: Nomenclature and importance of crown ethers. | 2 | 5 |
| **2** | **Aldehydes and Ketones** | **12** | |
| 2.1 | Preparation: Oxidation of primary and secondary alcohols using PCC, reduction of esters using DIBAL-H, Rosenmund | 2 | 1 |

| | | | |
|---|---|---|---|
| | reduction, Gattermann-Koch formylation and Friedel-Craft's acylation. | | |
| 2.2 | Chemical properties: Nucleophilic addition (HCN, NaHSO3, RMgX and ROH) | 1 | 5 |
| 2.3 | Addition-elimination reaction (with ammonia and ammonia derivatives). Addition reactions of unsaturated carbonyl compounds: Michael addition. | 1 | 5 |
| 2.4 | Reduction using Metal hydrides (mechanism expected), MPV reduction, Clemmenson and Wolff-Kishner reduction. | 2 | 5 |
| 2.5 | Oxidation: with KMnO4, Tollen's reagent, Fehling solution, Br2 water, Oppenaur oxidation, Baeyer-Villiger oxidation. | 2 | 5 |
| 2.6 | Acidity of α-hydrogen: Aldol, Claisen-Schmidt, Benzoin, Perkin and Knovenagel condensations (all mechanisms expected). | 2 | 5 |
| 2.7 | Haloform reaction – Iodoform test – Cannizaro reaction (mechanism expected) and Beckmann rearrangement (mechanism expected) | 2 | 5 |
| **3** | **Carboxylic acids, Sulphonic acid and their Derivatives** | **9** | |
| 3.1 | Preparation: Hydrolysis of nitrile, carboxylation of Grignard reagent and oxidation of alkyl benzenes. | 1 | 1 |
| 3.2 | Chemical properties: HVZ reaction, Decarboxylation – Kolbe electrolysis (Mechanism expected), Curtis reaction. Ascent and descent series in aliphatic carboxylic acids | 2 | 3,5 |
| 3.3 | Preparation, properties and uses of anthranilic acid, cinnamic acid, citric acid, lactic acid, oxalic acid, adipic acid and phthalic acid. | 3 | 1 |
| 3.4 | Formation of acid derivatives – acid chlorides, amides, acid anhydrides and esters – comparison of reactivity of acid derivatives. Preparation of coumarin – Fries rearrangement (Mechanism expected) | 3 | 5 |
| 3.5 | Preparation and reactions of benzene sulphonic acid, toluene sulphonic acid and benzene sulphonyl chloride – Importance of tosyl group – synthesis and application of saccharin. | 3 | 1,5 |
| **4** | **Organic Nitrogen Compounds** | **12** | |
| 4.1 | Nitrocompounds: Nitro-acitautomerism, Nef's reaction. Reduction of nitrobenzene in various media. Preparation of nitro toluenes, nitro compounds as explosives. | 3 | 5 |
| 4.2 | Amines: Classification – Preparation: From alkyl halides, nitro compounds, nitriles, isonitriles and amides – Hoffmann's bromamide reaction, Schmidt reaction, Gabriel phthalimide synthesis. | 2 | 1 |
| 4.3 | Chemical properties: Carbyl amine reaction, conversion of amines to alkene (Hoffmann elimination with mechanism), acylation, reaction with nitrous acid and Mannich reaction. | 2 | 5 |
| 4.4 | Electrophilic substitution reactions of aniline: halogenation, sulphonation and nitration by amino protection (acetylation). Benzidine rearrangement (mechanism expected). | 2 | 5 |
| 4.5 | Separation of mixture of amines – methods to distinguish | 1 | 2,5 |

| | | | |
|---|---|---|---|
| | primary, secondary and tertiary amines. Distinction between aliphatic and aromatic amines. | | |
| 4.6 | Preparation and synthetic applications of diazonium chloride and diazomethane. | 2 | 5 |
| **5** | **Carbohydrates** | **9** | |
| 5.1 | Classification and nomenclature of monosaccharides, configuration of monosaccharides. | 1 | |
| 5.2 | Reactions of glucose and fructose – Determination of openchain structure of D-glucose and D-fructose. | 3 | 4,5 |
| 5.2 | Anomers and mutarotation in glucose (mechanism expected) - cyclic structure – pyranose and furanose forms – Haworth projection formula – chair conformations. | 2 | 4 |
| 5.3 | Epimers and epimerization – Interconversion of aldoses and ketoses – chain lengthening and shortening of aldoses. | 1 | 3 |
| 5.4 | Disaccharides – reactions and structure of sucrose (structural elucidation not required) Polysaccharides – Structure of starch and cellulose (structural elucidation not required) – Industrial applications of cellulose. | 2 | 4 |
| **6** | **Organometallics, Active methylene compounds and Reagents in Organic synthesis** | **9** | |
| 6.1 | Organomagnesium compounds: Grignard reagent: Preparation – Reaction with compounds containing acidic hydrogen, carbonyl compounds, cyanides and CO2. | 2 | 1,6 |
| 6.2 | Organo lithium compounds: Preparation – Reaction with compounds containing acidic hydrogen, alkyl halides, carbonyl compounds, cyanides and CO2. | 1 | 1,6 |
| 6.3 | Organo zinc compounds: Preparation of dialkyl zinc – Reaction with active hydrogen compounds, acid halides and alkyl halides, Reformatsky reaction (mechanism expected) Li dialkylcuprates – Preparation and reaction with aliphatic/aromatic/vinyl halides. | 2 | 1,6 |
| 6.4 | Active methylene compounds – examples. Preparation of ethyl acetoacetate by Claisen condensation (mechanism expected), tautomerism, Synthetic applications of acetoacetic ester. | 2 | 1,6 |
| 6.5 | Reagents in organic synthesis: Study of the following reagents with respect to functional group transformations – 1. LiAlH4 – reduction of =CO, -COOR and –CONH2. 2. NaBH4 and Diborane – reduction of =CO 3. SeO2 - hydroxylation of allylic and benzylic positions, oxidation of CH2 alpha to =CO to =CO 4. NBS : Allylic and benzylic bromination. | 2 | 6 |
| **7** | **Introducing supramolecular and green chemistry** | **6** | |
| 7.1 | Supramolecular chemistry: Introduction – molecular recognition – host-guest interactions – types of non-covalent interactions. | 2 | 7 |

| | | | |
|---|---|---|---|
| 7.2 | Green Chemistry: Introduction – atom economy – principles of greenchemistry. | 2 | 7 |
| 7.3 | Newer methods of synthesis : Ultrasound, microwaves and phase transfer catalysis. | 2 | 7 |

**Text books**


1. A.Bahl and B.S.Bahl, Advanced Organic Chemistry, S.Chand& Company, New Delhi.
2. L.G.Wade Jr, Organic Chemistry, Pearson Education, New Delhi.
3. K.S.Tewari, N.K.Vishnoi and S.N.Mehrotra, A textbook of Organic Chemisty, Vikas Publishing House (Pvt) Ltd., New Delhi..
4. S.C.Sharma and M.K.Jain, Modern Organic Chemistry, Vishal Publishing Company, New Delhi.
5. I L Finar, "Organic Chemistry" Vol – 1, 5th Edition, Pearson Education, New Delhi.
6. J. Clayden, N.Greeves and S.Warren, Organic Chemistry, Oxford University Press, New York.
7. Helena Dodzuik, Introduction to supramolecular chemistry, Springer.
8. V.K.Ahluwalia, Green Chemistry, Enviornmentally Benign reaction, Ane Book.


**For further reading:**


1. L.M. Lehn, Supramolecular Chemistry, VCH.
2. M.M.Sreevastava and Rashmi Sanghi, Green Chemistry for environment, Narosa Publishing House.
3. R.T.Morrison, R.N.Boyd. Organic Chemistry, Pearson Education, New Delhi.
4. P.Y.Bruice, Essential Organic Chemisty, Pearson Education, New Delhi.
5. G.M. Louden, Organic Chemistry, Oxford University Press, New York.
6. V.K.Ahluwaliya, Organic Reaction Mechanisms, Narosa Publishing House, New Delhi.


**UNIVERSITY OF KERALA**
**Model Question Paper of BSc Chemistry Programme**
**2020 Admission onwards**
**SEMESTER- V Core Course VII Course Code CH1543 Credit 4**
**ORGANIC CHEMISTRY II**

**Time:3 hours** **Max.Marks : 80**

**SECTION – A**

*(Answer **all** questions. Answer in **one** word to maximum **two** sentences. **Each** question carries **one** mark)*

1. What is Williamson's synthesis?
2. Which reagent is used for the oxidative cleavage of 1,2-diols?
3. Give a test to distinguish aliphatic aldehydes from aromatic aldehydes.
4. What is atom economy?
5. What is HVZ reaction?
6. What happens when aniline is treated benzoyl chloride in alkaline medium?
7. Draw the structure of D-Arabinose and D-Ribose?
8. What are epimers?
9. What is Frankland reagent?
10. Name a nitro compound used as explosive.

**(10 X 1 =10 Marks)**

## SECTION - B

(*Short answer type. Answer **any 8** questions from the following. **Each** question carries **two** marks.)*

11. What is Mannich reaction?
12. How can you convert isopropanol to *tert*-butyl alcohol?
13. How can you distinguish 2-pentanone from 3-pentanone?
14. What is MPV reduction?
15. How coumarin is prepared?
16. How will you convert acetic acid to propionic acid?
17. Explain Nef's reaction.
18. Write the mechanism of Benzidine rearrangement.
19. Explain inversion of cane sugar.
20. Write any two industrial applications of cellulose.
21. What is NBS? What is its use?
22. What is DIBAL? What is its use?

**(8 X 2 = 16 Marks)**

## SECTION - C

(*Short essay type. Answer **any 6** questions from the following. **Each** question carries **four** marks.)*

23. Explain Zeisel's method of estimating methoxy group?
24. How can you distinguish primary, secondary and tertiary alcohol?
25. Write the importance of $LiAlH_4$ and $NaBH_4$ in carbonyl chemistry.
26. Comment on Clemmensen and Wolff-Kishner reduction.
27. How cinnamic acid is prepared? Explain its important properties.
28. Discuss Hoffmann elimination?
29. Explain microwave synthesis with examples.
30. Discuss the mechanism of Reformatsky reaction.
31. What is mutarotation? Explain its mechanism.

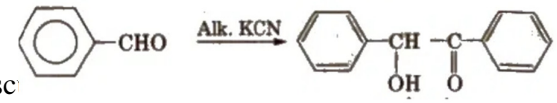
**6 X 4 = 24marks)**

## SECTION – D

(*Answer **any 2** questions. Each question carries 15marks*)

32. (a) Write the mechanism of the following reactions:

a. (a)



(b) Disc action and (ii) Claisen Condensation.

(c) Comment on the following (i) Biodiesel and (ii) Crown ethers.
(5+5+5)

33. (a) Explain the synthesis and applications of saccharin.

(b) How diazonium chloride is prepared? How is it useful to synthesis the following compounds: phenol, iodobenzene, azocompounds,

(c) How can you effect the following conversions (i) aniline to para-bromo aniline(ii) benzamide to aniline.
(5+5+5)

34.(a) Discuss the cyclic structure of glucose
(
(b) (i) Why glucose and fructose form same osazone?

(ii) How fructose reacts with the following reagents?

(1) Na/Hg and $H_2O$ (2) $CH_3OH$ and dry HCl (3) Fehling's solution.

(c) Discuss the application of the following reagents in organic synthesis (i) SeO2 (ii) Lithium alkyl cuprate.

(5+5+5)

35. (a) How primary, secondary and tertiary amines are separated?

(b) Discuss the preparation and important reactions of benzene sulphonic acid.

(c) Discuss the different types of non covalent interactions in molecules. (5+5+5)

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**

**2020 Admission onwards**

| | |
|---|---|
| Semester | VI |
| Course | Core course-X |
| Course name | **PHYSICAL CHEMISTRY II** |
| Course Code | CH 1641 |
| Credit | 4 |
| Hours | 72 hours |
| Lecture-Tutorial-Lab | 4-0-2 |

| **CO No.** | **COURSE OUTCOME**<br>*Upon completion of this course, the students* | **Cognitive level** | **PSO** |
|---|---|---|---|
| 1 | Understand basic concepts of thermodynamics , spectroscopy and group theory | U | PSO11 |
| 2 | Apply laws of thermodynamics in physical and chemical processes and real system | A | PSO1 |
| 3 | Classify processes, properties and systems on a thermodynamic basis | | PSO3 |
| 4 | Discuss the second law of thermodynamics and Assess thermodynamic applications using second law of thermodynamics. | E, A | PSO3 |
| 5 | Discuss basic concepts of statistical thermodynamics | U | PSO11 |

| | | | |
|---|---|---|---|
| 6 | Solve numerical problems based on thermodynamics and thermochemistry | | PSO2 |
| 7 | Understand the basics of spectroscopic techniques-Rotational, Vibrational and Raman Spectroscopy | U | PSO2 |
| 8 | Compare NMR and ESR spectroscopy and their applications | U | PSO3 |
| 9 | Evaluate physical and chemical quantities using non-spectroscopic techniques. | U, E | PSO4 |
| 10 | Identify the elements of symmetry and Determine the point groups of simple molecules | E | PSO11 |
| 11 | Differentiate diamagnetism and paramagnetism, measurement of magnetic susceptibility | U | PSO11 |
| 12 | Correlate dipole moment with geometry of molecules | R, U | PSO11 |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **1** | **Thermodynamics I** | **9** | |
| 1.1 | Types of processes, zeroth law of thermodynamics. | 1 | 1 |
| 1.2 | Definition of internal energy and enthalpy<br>Heat capacities at constant volume (Cv) and at constant pressure (Cp), relationship between Cp and Cv. | 1 | 2 |
| 1.3 | First law of thermodynamics, mathematical form, (numerical problems) | 1 | 2 |
| 1.4 | Reversible process and maximum work. Calculation of work, heat, internal energy change and enthalpy change for the expansion of an ideal gas under reversible isothermal and adiabatic condition.<br>(numerical problems) | 2 | 2 |
| 1.5 | The Joule-Thomson effect – isoenthalpic process, Joule-Thomson coefficient, derivation of the expression for Joule-Thomson coefficient. Sign and magnitude, inversion temperature-in terms of van der waal's constant. | 1 | 2 |
| 1.6 | Thermochemistry – Standard state. Standard enthalpies of reactions: Enthalpies of formation, combustion and neutralization. Enthalpies of solution -Integral and differential enthalpies of solution.<br>Hess's law and its applications. Kirchoff's equations. | 3 | 2 |
| **2** | **Thermodynamics II** | **9** | |
| 2.1 | Limitations of Ist Law, Need for II$^{nd}$ law of thermodynamics. Spontaneous process. | 1 | 3 |

| | | | |
|---|---|---|---|
| 2.2 | Carnot cycle:-net work done and efficiency of Carnot engine, Carnot theorem. Different statements of $II^{nd}$ law | 2 | 3 |
| 2.3 | Thermodynamic scale of temperature<br>Concept of entropy- Definition and physical significance. Entropy as a function of volume and temperature, pressure and temperature, as a criterion of spontaneity and equilibrium. Entropy changes in reversible and irreversible processes. Entropy change accompanying change of phase, solid to liquid, liquid to vapour, one crystalline form to another | 2 | 3 |
| 2.4 | Free energy: Gibbs and Helmholtz free energies and their significances - criteria of thermodynamic equilibrium and spontaneity. Gibbs-Helmholtz equation, dependence of Gibbs free energy changes on temperature, volume and pressure. Significance of Gibbs-Helmholtz equation. | 2 | 3 |
| 2.5 | Partial molar quantities. Chemical potential-Gibbs-Duhem equation, Clapeyron – Clausius equation. Concept of fugacity, determination of fugacity by graphical method. | 2 | 3 |
| **3** | **Thermodynamics III & Statistical thermodynamics** | **12** | |
| 3.1 | Nernst heat theorem, proof and its consequences. Statement of $III^{rd}$ law-Plank's statement, Lewis Randall statement. Concept of perfect crystal, evaluation of absolute entropies of solid, liquid and gas. Exception to $III^{rd}$ law with reference to examples- CO, NO, $N_2O$ and $H_2O$ | 5 | 4 |
| **3.2** | Statistical thermodynamics: introduction, types of statistics- MB, BE and FD.<br>Ferminons and bosons, Phase space, system, assembly and ensemble-types of ensembles and uses. Thermodynamic probability, Boltzmann distribution law (no derivation).<br>Partition function, molecular partition function for ideal gas | 4 | 4 |
| **3.3** | Thermodynamic functions in terms of partition functions - internal energy, enthalpy, pressure, work function and free energy function | 3 | 4 |
| **4** | **Spectroscopy I** | **12** | |
| 4.1 | Regions of electromagnetic spectrum. Different units of energy (erg, Joule, calorie, an $cm^{-1}$, Hz, $A^0$ and eV) and their interconvertions. Interaction with mater- Quantization of energy- photon,various types of molecular excitation and types of molecular spectra. Born-Oppenheimer approximation. | 2 | 5 |

| | | | |
|---|---|---|---|
| 4.2 | Rotational spectroscopy: Interaction between molecules and microwaves and criteria for microwave activity, rotation of molecules: Types of molecules according to moments of inertia- linear, symmetric top, asymmetric top and spherical top with two examples each.<br>Microwave spectroscopy of rigid diatomic molecules, derivation for $I= \mu r^2$. energy expression, rotational constant,rotational energy levels, selection rule, pure rotational spectra. Separation between spectral lines, equation of J for maximum intensity (no derivation), determination of bond length. | 2 | 5 |
| 4.3 | Vibrational spectroscopy: Criteria for IR activity, Simple Harmonic oscillator model; Hooks law, energy and frequency equations. IR spectra of diatomic molecules. Energy expression, Selection rules, Zero-point Energy, frequency of separation, calculation of force constant, anharmonic oscillators, Morse equation. Energy expression and Selection rules, Fundamental and overtone transitions. Combination bands. Degree of freedom of polyatomic molecules. | 2 | 5 |
| 4.4 | Raman spectroscopy: Rayleigh and Raman Scattering, Stoke's and antistoke's lines and their intensity difference. Interaction between molecules and IR radiations and criteria for Raman activity, Induced dipole moment and polarizability, Pure Rotational Raman spectra. Selectionrule. Frequency of separation, vibrational Raman spectra, Selection rule, Rule of Mutual exclusion, (example;$CO_2$) | | 5 |
| **5** | **Spectroscopy II** | **12** | |
| 5.1 | Electronic spectroscopy of molecules: Selection rule, Vibrational Coase Structure, Frank-Condon principle-Diagram, spectrum and continuum. | 2 | 6 |
| 5.2 | Dissociation and dissociation energy, Determination of Dissociation energy (equation only), Predissociation.<br>Electronic spectra of polyatomic molecules (qualitative idea only), Different types of electronic excitations. | 2 | 6 |
| 5.3 | NMR spectroscopy: Principle of NMR, nuclear spin. H-NMR, Interaction of nuclear spin with external magnet. Energy level splitting, Precession. | 2 | 6 |
| 5.4 | Chemical shift. Delta and tau scales. Presentation of NMR spectra, Low resolution spectra and high resolution spectra,-Spin-spin coupling | 2 | 6 |

| | | | |
|---|---|---|---|
| 5.5 | Electron spin resonance spectroscopy: Principle, Types of substances with unpaired electrons, interaction of electron magnet with external magnet. Energy level spliting. Lande splitting factor, | 2 | 6 |
| 5.6 | presentation of ESR spectrum, the normal and derivative spectra. Hyperfine splitting. Simple examples of methyl and benzene radicals. | 2 | 6 |
| **6** | **Non-spectroscopic methods** | **9** | |
| 6.1 | Dipole moment, Debye equation and Clausius-Mosotti equation, measurement of dipole moment by temperature method, Dipole moment and molecular structure. | 3 | 7 |
| 6.2 | Diamagnetism and paramagnetism, Magnetic susceptibility and unpaired electrons, measurement of magnetic susceptibility, | 3 | 7 |
| 6.3 | Molar refraction and molecular structure, Atomic refraction, Optical exaltation, Parachor and atomic equivalent of parachor. | 3 | 7 |
| **7** | **Group theory** | **9** | |
| 7.1 | Group theory: Elements of symmetry – Proper and improper axis of symmetry, plane of symmetry, centre of symmetry and identity element. Combination of symmetry elements, | 2 | 8 |
| 7.2 | Determination of point groups of simple molecules- Acetylene,H2O, NH3, BF3, [Ni(CN)4]2- and C6H6. | 2 | 8 |
| 7.3 | Symmetry operations. Order of a group. Combination of symmetry operations. Group theoretical rules. | 3 | 8 |
| 7.4 | Construction of Group multiplication table of C2V. | 2 | 8 |

**Text books**


1. B. R Puri,L. R Sharma,M. S.Pathania, Principles of Physical Chemistry,Vishal Publishing Company,
2. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Tata McGraw-Hill Education
3. A. SalahuddinKunju and G. Krishnan, Group Theory and its Applications in Chemistry, PHI Learning Pvt. Ltd
4. Ramakrishnan and M S Gopinathan, Group Theory in Chemistry, Vishal Publishing Co


**For Further Reading**


1. Gurdeep Raj, “Advanced Physical Chemistry”, Goel Publishing House
2. P W Atkins, “Physical Chemistry”, Oxford University Press
3. Physical Chemistry. Ira N Levine, McGraw Hill
4. R J Silby and R AAlberty, “Physical Chemistry”, John Wiley & Sons
5. S Glasstone, “Thermodynamics for Chemists”, Affiliated East West Publishers
6. G W Castellan, “Physical Chemistry”, Narosa Publishing House

7. M C Guptha, “Elements of Statistical Thermodynamics”, New Age International (P) Ltd.
8. L K Nash, “Elements of Statistical Thermodynamics”, Addison Wesley
9. ManasChanda, “ Atomic structure and Chemical bonding in Molecular Spectroscopy”, Tata McGraw Hill

**UNIVERSITY OF KERALA**

**Model Question Paper of B.Sc. Chemistry Programme**

**2020 Admission onwards**

**SEMESTER VI Core Course-X Course Code CH1641 Credit-4**

**PHYSICAL CHEMISTRY II**

**Time: 3 Hrs** **Total marks: 80**

**SECTION A**

**Answer all the questions. Each question carries 1 mark**

1. Which of the following will give pure rotational spectrum, $H_2$, $N_2$, CO2 or HCl.
2. Write the mathematical expression of first law of thermodynamics.
3. Which branch of spectroscopy is used for the identification of free radicals?
4. What is the significance of polarizability of a molecule?
5. Give the selection rule in vibrational spectroscopy.
6. State different symmetry elements in molecules.
7. Write the Clausius- Mosotti equation .
8. Differentiate delta and Tau scale.
9. Give the selection rule for rotational spectroscopy.
10. What is the unit of dipole moment?

**SECTION B**

**Answer any 8 questions** (Short answer type, 2 marks each),

11.Explain Hess’s law with an example.
12. Derive an expression for Joule Thomson coefficient
13. How will you account for the origin of second law of thermodynamics?
14. How will you correlate dipolemoment with geometry of molecules. Explain with two examples.
15. Discuss on symmetric top and asymmetric top molecules.
16. State mutual exclusion principle with an example.

17 What is meant by normal modes of vibrations?
18. Explain predissociation with diagram.
19. Calculate the number of fundamental modes of vibrations of CO2 and SO2 molecules.
20. How does stokes and anti stokes lines originate in Raman spectrum.
21. What do you mean by the term 'parachor'
22. Explain Chemical shift.

## SECTION C

**Each question carries 4 marks (Short essay), Answer any 6 questions**

23. What is an ensemble, explain the different types of ensembles.
24. Discuss the calcualation of workdone in irreversible expansion of an ideal gas under isothermal and adiabatic condition.
25. State and prove Nernst heat theorem. What are its consequences?
26. What is meant by Optical Exaltation? Calculate the optical exaltation of 2,6-dimethylhepta-2,5-dien-4-one.
27. Compare principle of NMR and ESR.
28. Explain the following terms Entropy and free energy. Explain why $T\Delta S$ determine randomness of a system?
29. Give an account of intensive and extensive properties.
30. Explain mutual exclusion rule with examples.
31. The fundamental vibrational frequency of carbon monoxide molecule is 2170. $cm^{-1}$ Calculate the force constant of the molecule.

## SECTION D

**Answer any two** question , 15 marks each

32. a) What is meant by reversible process? Derive an expression for work done in the reversible isothermal expansion of an ideal gas. (5 marks)

b) Calculate the work done in expanding one mole of an ideal gas from a volume of 2 to 20 $dm^3$ at 27 $^0C$ (5 marks)

c) Derive the relation between Cp and Cv. (5 marks)

33. a) Give an account of different statistical approaches (6 marks)

b) Show that for a rigid diatomic rotor, the moment of inertia is given by $I = \mu r^2$

c) The pure rotational spectrum of a gaseous molecule CN consists of a series of equally spaced lines separated by 3.7978cm$^{-1}$. Calculate the internuclear distance of the molecule. The molar masses are; $^{12}$C=12.011 and $^{14}$N=14.007 g mol$^{-1}$.

34. a) How can NMR spectrum distinguish between the isomers: p-xylene and ethyl benzene?

b) Explain the shielding and deshielding mechanism in NMR.

c) Give the hyperfine structure of ESR spectrum of hydrogen atom. Calculate the ESR frequency of an unpaired electron in a magnetic field of 0.33T. Given ge = 2 and μB = 9.273x10-24 JT$^{-1}$.

35. a) Discusson order of a group (5 marks)

b) Explain Frank Condon principle with diagram. (5 marks)

c) Draw the group multiplication table of C2vpoint group (5 marks)

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**

**2020 Admission onwards**

| | |
|---|---|
| Semester | VI |
| Course | Core course-XI |
| Course name | **ORGANIC CHEMISTRY III** |
| Course Code | CH 1642 |
| Credit | 4 |
| Hours | 72 hours |
| Lecture-Tutorial-Lab | 3-0-2 |

| CO No. | **COURSE OUTCOMES** *Upon completion of this course, the students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Outline the chemistry of simple heterocyclic compounds | U | PSO10 |
| 2 | Classify amino acids, proteins, nucleic acids, drugs, terpenes, vitamins, lipids and polymers. | U | PSO10 |
| 3 | Discuss the synthesis of amino acids, peptides, drugs and polymers. | U | PSO9 |
| 4 | Describe the isolation and structure of terpenes and alkaloids. | R | PSO10 |
| 5 | Explain the mechanism and techniques of polymerisation. | U | PSO11 |

| | | | |
|---|---|---|---|
| 6 | Discuss the principle of UV, IR, NMR and Mass spectroscopy. | U | PSO2 |
| 7 | Interpret spectroscopic data to elucidate the structure of simple organic compounds. | A | PSO18 |
| 8 | Use the simple organic reactions to elucidate the structure of quinoline, piperine and conine. | A | PSO18 |

R-Remember, U-Understand, A-Apply.

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **1** | **Heterocyclic compounds and Drugs** | **9** | |
| 1.1 | Heterocyclic compounds- classification,nomenclature, aromaticity. Basicity of pyridine and pyrrole. | 1 | 1 |
| 1.2 | Preparation - Paal-Knor synthesis and Hantzsch synthesis. Properties of furan, pyrrole, thiophene and pyridine. | 2 | 1 |
| 1.3 | Synthesis and reactions of quinoline, isoquinoline and indole with special reference to Skraup, Bischler-Napieralski and Fischer-Indole synthesis. | 2 | 1 |
| 1.4 | Structural elucidation of quinoline. Structure of purine and pyrimidine bases. | 1 | 1,8 |
| 1.5 | Drugs – introduction – classification on the basis of application | 1 | 2 |
| 1.6 | Synthesis and use of sulphanilamide, sulphathiazole,sulphapyridine, paracetamol and aspirin. Mode of action of sulphadrugs and amphicillin. Elementary idea of the structure and application of chloroquine, ibrufen and phenobarbitol. | 2 | 3 |
| **2** | **Amino acids, proteins and nucleic acids** | **9** | |
| 2.1 | Amino acids – classification, structure and stereochemistry of amino acids, | 2 | 2 |
| 2.2 | Essential and non essential amino acids – zwitter ion, isoelectric point. | 1 | 2 |
| 2.3 | Synthesis of amino acids – Strecker synthesis, Gabriel phthalimide synthesis, Erlenmeyer azlactone synthesis. Peptides: Structure and synthesis ( Carbobenzoxy, Sheehan and solid phase synthesis) | 2 | 3 |
| 2.4 | Proteins – classification of proteins – structure of proteins – denaturation and colour reactions. | 2 | 2 |
| 2.5 | Nucleic acids: Classification, structure of DNA and RNA. Replication of DNA. Transcription and Translation - Genetic code. | 2 | 2 |
| **3** | **Natural products** | **9** | |
| 3.1 | Terpenes – Classification - Isoprene rule - Essential oil – Source | 1 | 2,4 |
| 3.2 | Structure (no structural elucidation) and uses of citral, geraniol, limonene and menthol. Structure of natural rubber – vulcanization and its advantages. | 1 | 4 |

| | | | |
|---|---|---|---|
| 3.3 | Alkaloids – Extraction. Structure and importance of nicotine, quinine, morphine and codeine. | 2 | 4 |
| 3.4 | Structural elucidation of piperine and conine. | 2 | 8 |
| 3.5 | Vitamins : Classification, structure, functions and deficiency diseases (structure of vitamin A, B1 and C only - no structural elucidation). | 1 | 2 |
| 3.6 | Lipids – biological functions – oils and fats - Common fatty acids | 1 | 2 |
| 3.7 | Hydrogenation, rancidity, saponification value, iodine value and acid value. | 1 | 2 |
| **4** | **Soaps, Detergents and Polymers** | **9** | |
| 4.1 | Soaps and detergents: Soap – synthetic detergents – cleaning action of soap and detergents. | 1 | 2 |
| 4.2 | Polymers: General idea of monomers, polymers and polymerisation | 1 | 2 |
| 4.3 | Degree of polymerisation – polydispersity - number and weight average molecular mass. | 1 | 2 |
| 4.4 | Classification of polymers, Homopolymers and copolymers, Addition and condensation polymers, thermoplatstics and thermosets | 1 | 2 |
| 4.5 | Mechanism of addition polymerization (Cationic, anionic and free radical) | 1 | 5 |
| 4.6 | Coordination polymerization - Ziegler Natta catalyst - Tacticity in polypropylene. | 1 | 2 |
| 4.7 | Polymerisation techniques – Bulk, solution and emulsion polymerization (Elementary idea) | 1 | 5 |
| 4.8 | Addition polymerization- Preparation and uses of (i) polyethylene (ii) PVC (iii) Teflon Condensation polymerization - (i) phenol-formaldehyde resin (ii) epoxy resin (iii) nylon-66 (iv) polyethylene terephthalate. | 1 | 2 |
| 4.9 | Synthetic rubbers – SBR and nitrile rubbers.<br>Additives to polymers – Plasticisers, stabilizers and fillers.<br>Biodegradable polymers (Basic idea only). | 1 | 2 |
| **5** | **Organic Spectroscopy I** | **9** | |
| 5.1 | UV–Visible spectroscopy – Beer-Lambert's law, types of electronic transitions, bathochromic, hypsochromic shifts, hyperchromic and hypochromic effects. | 2 | 6 |
| 5.2 | UV-Visible spectra of enes, effect of conjugation – solvent effect - Calculation of $\lambda$max of dienes and $\alpha,\beta$-unsaturated ketones. | 2 | 6 |
| 5.3 | IR spectroscopy – Molecular vibrations, Functional group and finger print region – group frequencies, effect of hydrogen bonding on –OH stretching frequency. | 3 | 6 |
| 5.4 | Factors influencing carbonyl stretching frequency. Comparison of carbonyl stretching frequency in compounds containing carbonyl group. | 1 | 6 |
| 5.5 | Interpretation of IR spectra of simple organic molecules such as | 1 | 7 |

| | | | |
|---|---|---|---|
| | salicylaldehyde, benzamide, acetophenone, nitro benzoic acid and phenyl acetate. | | |
| **6** | **Organic Spectroscopy II** | **9** | |
| 6.1 | NMR spectroscopy – principle of proton NMR, shielding and deshielding effect. | 2 | 6 |
| 6.2 | chemical shift, factors influencing chemical shift | 1 | 6 |
| 6.3 | spin-spin splitting, coupling constant, interpretation of PMR spectrum of simple molecules like $CHBr_2CH_2Br$, ethylbromide, pure ethanol and impure ethanol (acidic impurities) acetaldehyde and toluene. Introduction to $^{13}C$ NMR | 3 | 6 |
| 6.4 | Structural elucidation of simple organic molecules using IR and NMR spectroscopic techniques. | 1 | 7 |
| 6.5 | Theory of Mass spectrometry – mass spectrum, base peak and molecular ion peak, types of fragmentation, McLafferty rearrangement, isotopic effect. | 2 | 6 |

**Textbooks:**


1. A.Bahl and B.S.Bahl, Advanced Organic Chemistry, S.Chand& Company, New Delhi.
2. K.S.Tewari, N.K.Vishnoi and S.N.Mehrotra, A textbook of Organic Chemisty, Vikas Publishing House (Pvt) Ltd., New Delhi..
3. S.C.Sharma and M.K.Jain, Modern Organic Chemistry, Vishal Publishing Company, New Delhi..
4. I L Finar, "Organic Chemistry" Vol – 1&2, 5th Edition, Pearson Education, New Delhi.
5. Gowariker V.R., Viswanathan N.V. and Jayader Sreedhar, Polymer Science, Wiley Eastern Ltd, New Delhi.
6. O.P.Agarwal, Chemistry of Natural Products, Goel Publications.
7. T.L.Gilchrist, Heterocyclic Chemistry, Pearson Education, New Delhi.
8. Y.R.Sharma, Elementary Organic Spectroscopy, Pearson Education, New Delhi.
9. William Kemp, Organic Spectroscopy, Macmillan, New York.
10. AshuthoshKar, Medicinal Chemistry, New Age International Publishers.


**For Further Reading:**


1. R.T.Morrison, R.N.Boyd. Organic Chemistry, Pearson Education, New Delhi.
2. P.Y.Bruice, Essential Organic Chemisty, Pearson Education, New Delhi.
3. J.Clayden, N.Greeves and S.Warren, Organic Chemistry, Oxford University Press, New York.
4. Billmeyer F.W., Text book of Polymer Science, John Wiley and Sons.
5. S.P.Bhutani, Chemistry of Biomolecules, Ane Book Pvt Ltd.
6. R.M.Silverstein and F.X.Webster, Spectrometric Identification of Organic Compounds, John Wiely and Sons, New York.
7. P.S.Kalsi, Application of Spectroscopic Techniques in OrganicChemistry, NewAge International, New Delhi.

**UNIVERSITY OF KERALA**

**Model Question Paper of B.Sc. Chemistry Programme**

**2020 Admission onwards**

**SEMESTER- VI Core Course XI Course Code CH1642 Credit 4**

**ORGANIC CHEMISTRY III**

Time:3hours Max.Marks: 80

## SECTION – A

*(Answer **all** questions. Answer in **one** word to maximum **two** sentences. **Each** question carries **one** mark)*

1. Write the IUPAC name of (i) Furan and (ii) quinoline.
2. Draw the structure of chloroquine.
3. What is isoelectric point?
4. What is natural rubber chemically?
5. Write any two biological functions of lipids.
6. What is soap?
7. Identify the types of electronic transitions in $CH_3CHO$.
8. What is base peak?
9. Write the monomers of the following polymers (i) PTFE (ii) PP.
10. What is SBR?

**(10 X 1 =10 Marks)**

## SECTION - B

(*Short answer type. Answer **any 8** questions from the following.**Each** question carries **two** marks.)*

11. Compare the aromaticity of furan and thiophene.
12. Write the structure of pyramidine bases present in nucleic acids.
13. Define the terms (i) saponification value and (ii) iodine value.
14. What is isoprene rule?
15. What are essential and non-essential amino acids?
16. What is denaturation of protein?
17. Differentiate oils and fats.
18. Define the terms $M_n$ and $M_w$
19. What is vulcanisation?
20. What are plastisizers?
21. Differentiate bathochromic and hypochromic shifts.
22. What is TMS? Why it is selected as a reference compound in $^1$H-nmr spectroscopy?

**(8 X 2 = 16 Marks)**

## SECTION - C

(*Short essay type. Answer**any 6**questions from the following.**Each**question carries**four**marks.)*

23. Explain the synthesis of amino acid by (i) Strecker and Erlenmeyer azlactone synthesis.
24. What are vitamins? How are they classified? Write the structure of Vitamin A and C.
25. What is tacticity? Explain it by taking poly propylene as an example.
26. What is Bakelite? How is it prepared? Give its important applications.
27. Write a short note on the structure of DNA.
28. Discuss the classification of drugs on the basis of application.
29. Elucidate the structure of conine.
30. (i) How can you distinguish inter and intra molecular hydrogen bonding using IRspectroscopy?
    (ii) Predict the regions where salicylaldehyde give IR absoptions.
31. Explain spin-spin coupling in 1,1,2-tribromo ethane and draw the $^{1}$HNMR spectrum of it.

**(6 X 4 =24marks)**

## SECTION – D

(*Answer**any2**question. Each question carries 15 marks*)

32. (a) Discuss the Woodward-Fieser rule for calculating $\lambda_{max}$ of dienes.
    (b) Explain the principle of nmr spectroscopy.
    (c) A compound with molecular formula $C_8H_8O$ shows the following absorptions:
        (i) IR Spectrum: 3050, 2950, 1700, 1620, 1550, 690 $cm^{-1}$.
        (ii) pmr spectrum: δ 7-8ppm (multiplet, 5H), 2.5ppm (singlet, 3H).
    Identify the structure of the compound. (5+5+5)
33. (a) Explain the Fischer-Indole synthesis.
    (b) What are sulphadrugs? Give examples. Explain the mode of action of sulphadrugs.
    (c) What are terpenes? How are they classified? Write the structure and uses of limonene
    and menthol. (5+5+5)
34. Write brief note on the following :
    (a) Replication of DNA
    (b) Merrifield synthesis
    (c) Structure of protein (5+5+5)
35. (a) Discuss on the factors influencing chemical shift in NMR spectroscopy.
    (b) Write brief note on the isotopic effect in mass spectroscopy.
    (c) Explain the mechanism of cationic and anionic polymerization. (7+4+4)

**(15 X 2 = 30marks)**

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**

**2020 Admission onwards**

| | |
|---|---|
| Semester | V |
| Course | Core course-XII |
| Course name | **PHYSICAL CHEMISTRY III** |
| Course Code | CH 1643 |
| Credit | 4 |
| Hours | 72 hours |
| Lecture-Tutorial-Lab | 4-0-2 |

| **CO No.** | **COURSE OUTCOMES**<br>*Upon completion of this course, the students* | **Cognitive Level** | **PSO** |
|---|---|---|---|
| 1 | Recall the basic physical concepts in quantum mechanics, colloids, adsorption, Chemical Kinetics, catalysis, chemical and ionic equilibria, phase equilibria, binary liquid systems and photochemistry | R | PSO4 |
| 2 | Understand the basic concepts involved in quantum mechanics, colloids, adsorption, Chemical Kinetics, catalysis, chemical and ionic equilibria, phase equilibria, binary liquid systems and photochemistry | U | PSO4 |
| 3 | Derive and Interpret important theories and equations involved in physical chemistry | A | PSO10 |
| 4 | Demonstrate the origin of quantum numbers by correlating the Cartesian and spherical polar coordinates of hydrogen atom. | A | PSO10 |
| 5 | Identify and recognize the applications of various principles, equations andphysical processes | U | PSO10 |
| 6 | Perform calculations involving physical concepts and equations | A | PSO4 |
| 7 | Analyze` graphical representations (phase diagrams, two and three components, vapour pressure – composition and boiling point –composition, temperature-composition) present in physical chemistry. | A | PSO9 |
| 8 | Understand terminology | U | PSO11 |

| | | | |
|---|---|---|---|
| 9 | Understand the effects of external influence on various chemical processes | U | PSO1 |
| 10 | Understand different laws and principles of physical chemistry | U | PSO3 |

| MODULE | COURSE DESCRIPTION | Hrs | CO number |
|---|---|---|---|
| **1** | **Quantum mechanics** | **12** | |
| 1.1 | Radiation phenomena- blackbody radiation, photoelectric effect, Compton effect and atomic spectra. Plank's quantum theory and explanation of the radiation phenomena. | 2 | 1,2,6 |
| 1.2 | Schrodinger wave equation – significance of Ψ, well behaved functions, Concept of operators and some operators of interest , Laplacian and Hermitian (properties of operators not required), Postulates of quantum mechanics | 3.5 | 1,2,5 |
| 1.3 | Application of quantum mechanics to simple systems - particle in 1 D box, normalization of wave function, Particle in 3 D box. Concept of degeneracy | 3.5 | 1,2,3,5,6 |
| 1.4 | Application to hydrogen atom (no derivation) Schrodinger wave equation in Cartesian and spherical polar co-ordinates, Quantum numbers. | 3 | 4 |
| **2** | **Colloids and Adsorption** | **12** | |
| 2.1 | Colloidal state: Classification of colloids- Kinetic, optical and electrical properties of colloids. | 1 | 1,2 |
| 2.2 | Purification of colloids – ultra filtration and electrodialysis, | 1 | 1,2 |
| 2.3 | Ultra microscope, Electrical double layer and zeta potential.Coagulation of colloids, Hardy-Schulz rule, Gold number.sedimentation and streaming potential | 2 | 1,2 |
| 2.4 | Gels: Elastic and non-elastic gels, Imbibition and syneresis, Micelles and critical micelle concentration | 2 | 1,2 |
| 2.5 | Application of colloids – Cottrell precipitator, purification of water and delta formation. | 1 | 1,2 |
| 2.6 | Adsorption: Physical and chemical adsorption, Freundlich adsorption isotherm, , | 2 | 1,2 |
| 2.7 | Derivation of Langmuir adsorption isotherm, Statement and explanation of BET and Gibbs isotherms | 2 | 1,2,3 |
| 2.8 | Determination of surface area of adsorbents by BET equation. Applications of adsorption | 1 | 1,2,5,6 |

| | | | |
|---|---|---|---|
| **3** | **Chemical Kinetics &Catalysis** | **12** | |
| 3.1 | Order of reaction, Derivation of integrated rate equation of zero, first, second and nth order reaction | 2 | 1,2,3,6 |
| 3.2 | Determination of order of reactions:- Graphical and analytical methods using integrated rate equations, Fractional life- method, Differential rate equation method, Isolation method. | 2 | 1,2,6,7 |
| 3.3 | Qualitative idea of Complex reactions:- (a) opposing reactions (b) first order consecutive reactions (c) parallel reactions. Qualitative idea of chain reactions. | 1.5 | 1,2 |
| 3.4 | Influence of temperature on rate of reaction: Arrhenius equation, Determination of Arrhenius parameter, Energy of activation and its significance. | 2.5 | 1,2,3,6,9 |
| 3.5 | Collision theory, Derivation of the rate equation for a second order reaction based on collision theory, unimolecular reactions- Lindemann mechanism, steady state approximation. | 2 | 1,2,3,10 |
| 3.6 | Catalysis:- Theories of catalysis, Intermediate compound formation theory, steady state method | 1 | 1,2,10 |
| 3.7 | Enzyme catalysis, Michaelis-Menten law. | 1 | 1,2,3,10 |
| **4** | **Chemical and Ionic Equilibria** | **12** | |
| 4.1 | Equilibrium constant and free energy | 1 | 1,2,6 |
| 4.2 | Thermodynamic derivation of law of mass action, relation between Kp,Kc and Kx | 1 | 1,2,3 |
| 4.3 | Le-Chatelier'sPrinciple – Application in Haber process and dissociation of $PCl_5$ | 1 | 1,2,3,5,9,10 |
| 4.4 | Reaction isotherm, Temperature dependence of equilibrium constant, Pressure dependence of equilibrium constant | 2 | 1,2,9 |
| 4.5 | Application of Clausius-clapeyron equation in physical equilibria. | 2 | 1,2,3,5,6 |
| 4.6 | Ionic equilibrium : Ionic product of water, Effects of solvents on ionic strength, levelling effect, | 1 | 1,2,5,6,8 |
| 4.7 | pKa and pKb values, solubility product and common ion effect and their applications | 1 | 1,2,3,5,6,8 |
| 4.8 | pH and its determination by indicator methods, buffer solution, buffer action, Henderson's equation, buffer capacity | 1 | 1,2,3,5,6,8 |
| 4.9 | hydrolysis of salts of all types, degree of hydrolysis and hydrolytic constant, determination of degree of hydrolysis, relation between hydrolytic constant and ionic product of water | 2 | 1,2,3,6,8 |

| | | | |
|---|---|---|---|
| **5** | **Phase Equilibria** | **12** | |
| 5.1 | Phase Equilibria:-Terminology, the phase rule, thermodynamic derivation of phase rule | 1 | 1,2,3,6,8 |
| 5.2 | application to (a) water system (b) sulphur system (c) solid-liquid equilibria involving simple eutectic system such as Pb-Ag system, KI-water system | 3 | 1,2,6,7 |
| 5.3 | application to solid-liquid equilibria involving simple eutectic system such as Pb-Ag system, KI-water system | 2 | 1,2,6,7 |
| 5.4 | freezing mixtures, thermal analysis and desilverisation of lead | 1 | 1,2,7,8 |
| 5.5 | solid-liquid equilibria involving compound formation with congruent and incongruent melting points:- $FeCl_3$-$H_2O$ system and $Na_2SO_4$-$H_2O$ system | 3 | 1,2,6,7,8 |
| | solid–gas system- decomposition of $CaCO_3$, dehydration of $CuSO_4.5H_2O$, deliquescence and efflorescence. | 2 | 1,2,6,7,8 |
| **6** | **Binary Liquid Systems** | **9** | |
| 6.1 | Liquid-Liquid system:- Completely miscible, ideal and non-ideal mixtures, | 1 | 1,2 |
| | Raoult's law, vapour pressure- composition, temperature-composition curves | 2 | 1,2,5,7,10 |
| 6.2 | fractional distillation, deviation from Raoult's law | 1 | 1,2,5,8 |
| 6.3 | Azeotropic mixtures, partially miscible liquid system, critical solution temperature, Conjugate layers, example for upper, lower and upper cum lower CST | 2 | 1,2,5,8 |
| 6.4 | Introduction to three component system, distribution law, its thermodynamic derivation, limitations of distribution law. | 2 | 1,2,3,5,10 |
| 6.5 | Application of distribution law to the study of association and dissociation of molecules | 1 | 1,2,5,6 |
| **7** | **Photochemistry** | **3** | |
| 7.1 | Grothus-Draper, Beer- Lambert and Stark- Einstein laws. | 1 | 1,2,6,10 |
| 7.2 | Quantum yield, Reason for very low and very high quantum yields, Rate equation for decomposition of hydrogen iodide, Qualitative treatment of $H_2$-$Cl_2$ reaction and $H_2$-$Br_2$ reaction | 1 | 1,2,9 |
| 7.3 | Fluorescence and phosphorescence, chemiluminescence and photosensitization, Explanation and examples | 1 | 1,2,5,8 |

**Textbooks**

1. Puri, Sharma & Pathania, Priniciples of Physical Chemistry, Vishal Publishing Co
2. Elements of Physical Chemistry , Glasstone and Lewis,Macmillan
3. ,P.C.Rakhit, Physical Chemistry,Sarat Book House,Calcutta
4. I N Levine, Quantum Chemistry, Prentice Hall

5.RL Madan ,Physical Chemistry, Mc Graw Hill

**For Further Reading**

1.R J Selby and RA Alberty, Physical Chemistry,John Wiley &sons
2. Levin, Physical Chemistry , 5th edn ,TMH
3 Bahl, Arun Bahlan dG D Tuli,Essentials of Physical Chemistry , S Chand Ltd
4. S.C.Anand, A text book of Physical Chemistry, New Age International publishers.
5.Gurdeep Raj, Advanced Physical Chemistry, Goel publishing house

**UNIVERSITY OF KERALA**
**Model Question Paper of B.Sc. Chemistry Programme**
**2020 admissions onwards**
**SEMESTER VI Core Course XII: Course Code CH1643 Credit 4**
**PHYSICAL CHEMISTRY – III**

**Time: 3 Hrs** **Total marks: 80**

**SECTION A**

**Answer all the questions Each question carries 1 mark**

1. Name two quantum mechanical operators
2. Give the Arrhenius equation.
3. Write the integrated rate equation for a first order reaction.
4. Give the relation between hydrolytic constant, dissociation constant and ionic product of water of a salt of strong acid and weak base.
5. The solubility of AgCl in water at 250C is 0.00179 g/L. calculate its solubility product at 25 $^0$C.
6. Write Debye- Huckel- Onsagar equation.
7. Write the reduced phase rule equation.
8. Give an example for a system having upper cum lower CST.
9. Give the Nernst equation for the potential of a copper electrode.
10. What is meant by quantum yield of a photochemical reaction?

.

## SECTION B

Each question carries 2 marks (Short answer) **.** Answer any **8** questions

11. Explain an eigen function with an example.
12. Give the normalization condition of a wave function.
13. Give one example each for an acidic and a basic buffer.
14. Define buffer solution and buffer index
15. Define the term activation energy. Why different reactions proceed at different rates?
16. What is meant by common ion effect? Explain with an example.
17. Describe with example (i) Triple point (ii) Eutectic point
18. Explain the term congruent melting point with an example
19. Write a note on ionic product of water
20. Differentiate between pKa and pKb values.
21. How will you characterise the triple point of water?
22. What is meant by phosphorescence?

## SECTION C

**Answer any 6 questions**. Each question carries 4 marks (Short essay).

23. Discuss postulates of quantum mechanics
24. The rate constant of a second order reaction is $5.70 \times 10^{-5} dm^3 mol^{-1} S^{-1}$ at $25^0C$ and $1.64 \times 10^{-4} dm^3 mol^{-1} S^1$ at $40^0C$. Calculate the activation energy and the Arrhenius preexponential factor
25. What would be the pH of a solution obtained by mixing 5 g of acetic acid and 7.5 g of sodium acetate and making the volume equal to 500 ml? Dissociation constant of acetic acid at 250C is $1.75 \times 10^{-5}$.
26. Explain the principle of freezing mixture by taking KI – H2O system as an example
27. State and explain Nernst distribution law. What are the limitations of the law?
28. Write notes on ultra filtration and electrodialysis.
29. Discuss on a consecutive and a parallel reactions with examples
30. What are the laws of photochemistry , explain ?
31. Explain the phase diagram of Pb-Ag system

.

## SECTION D

**Each question carries 15 marks ,Answer any two questions**

32. a) using Le Chatliers Principle, describe the effect of temperature, pressure and concentration for the following systems in equilibria:
    1) Formation of $NH_{3(g)}$ from $N_{2\,(g)}$ and $H_{2(g)}$
    2) Dissociation of $PCl_{5(g)}$ in to $PCl_{3(g)}$ and $Cl_{2(g)}$ (6 marks)

    b)Derive the rate equation for a second order reaction based on collision theory. ( 4 marks)
33. a)What is critical solution temperature? How does it vary by the addition of an

electrolyte?

((5 marks)

b) What is meant by CST. Explain different types of CST with examples (6 marks)

c) Elaborate on azeotropic mixtures with examples (4 marks)

34. a)Derive van't Hoff equation for temperature dependence of equilibrium constant

b)The equilibrium constant for a reaction is 1× 105. Calculate the standard free energy change

for the reaction in kilojoules at 25? C.

c) The half life of a first order reaction is 50 min. Calcualate the time required to reduce the initial concentration to 12.5%. (5x3=15 marks)

35. a) Write note on (i) Fluorescence (ii) Chemiluminescence (5 marks)

b) Derive Langmuir adsorption isotherm (5 marks)

c) Explain the phase diagram of water (5 marks)

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## LAB COURSES

**(For all Lab courses scheme of ESE is decided by the board of examiners in each year)**

**Computer Lab for**

**Foundation Course II (CH 1221) SEMESTER II**

**(No ESE)**

| | |
|---|---|
| Semester | II |
| Hours | 2 hours/week |
| Lecture-Tutorial-Lab | 0-0-2 |

| CO No. | COURSE OUTCOME<br>*Upon completion of this course, the students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Get acquainted with Computer Lab based instruction on the use of computer and internet in learning. | U | PSO5 |
| 2 | Use of educational softwares, information mining from internet and using INFLIBNET/NICNET, NPTEL and VIRTUAL LABS OF MHRD. | A | PSO5 |
| 3 | Learn Word processing and document preparation. Use of Spread sheets in Data handling and presentation | U | PSO5 |
| 4 | Develop skill in chemical structure drawing and visualization of molecules using chemistry softwares | U | PSO5 |

**Students should submit the following documents, certified by Teacher in charge, along with LAB COURSE I records for ESE**

**1. Structure of any five simple organic molecules using Chem Sketch or Chemdraw**

**2. Any five chemistry related graphical plots using Excel**

.

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**2020 Admission onwards**
**Core Course-II**
**LAB COURSE I**
**INORGANIC QUALITATVE ANALYSIS**
**(ESE at IV Semester)**

**Time 3Hrs** **Marks 80**

| | |
|---|---|
| Semester | I,III &IV |
| Course | **Core Course-IV, Lab Course I** |
| Course name | **Inorganic Qualitative Analysis** |
| Course Code | **CH1442** |
| Credit | 2 |
| Hours | 2 hours/week |
| Lecture-Tutorial-Lab | 0-0-2 |

| CO No. | **COURSE OUTCOME**<br>*Upon completion of this course, the students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Obey Lab safety instructions, develop qualities of punctuality, regularity and scientific attitude, out look and scientific temper (GOOD LAB PRACTICES) | U | PSO1 |
| 2 | Develop skill in safe handling of chemicals, take precaution against accidents and follow safety measures | A | PSO2/ PSO8 |
| 3 | Use glass wares ,electric oven, burners and weighing balance | A | PSO1 |
| 4 | Develop skill in observation , prediction and interpretation of reactions | A | PSO1 |
| 5 | Detect solubility, and classify compounds according to their solubility | U | PSO3 |
| 6 | Apply the principle of common ion effect and solubility | A | PSO1& |

| | | | |
|---|---|---|---|
| | product in the identification and separation of ions | | PSO2 |
| 7 | Develop skill in preparing and purifying inorganic complex compounds | A | |
| 8 | Use filtration and chomatographic techniques, vacuum pump and centrifugal pumps | U | PSO4 |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **I** | **Lab Safety Measures** | **36** | 1 |
| ***A*** | ***General Instructions*** | **10** | |
| 1 | Readiness to follow Laboratory rules and regulations and cooperating with Lab instructors and staff for avoiding accidents | 2 | |
| 2 | Laboratory safety measures, develop safety skills by wearing lab coats, gloves and safety eye glasses wherever necessary (Necessity of **FIRST AID** and of keeping first Aid box in Lab) | 2 | |
| 3 | Procedures adopted in chemical splashes to skin, eyes, burns and electric shock, Instruction for emergency use of **Fire extinguishers in Lab** | 2 | |
| 4 | Labels and warning symbols for Safe handling of Toxic and corrosive chemicals | 4 | |
| ***B*** | ***Experimental and scientific Skills*** | **26** | 3,4 |
| 1 | Preparation of solution, Precipitation, Dissolution, Crystallisation techniques | 4 | |
| 2 | Use of Bunsen Burner, Electric Burners , advantages and disadvantages -Ignition tests,Flame tests and ash tests for detection of cations and anions | 4 | |
| 3 | Filtration techniques-Filter paper, Electric Centrifuge, Vacuum pump | 2 | |
| 4 | Purification technique-Washing of precipitates,Re-crystallsation and drying of precipitate | 4 | |
| 5 | Writing experimental procedures | 2 | |
| 6 | Reporting, Tabulation of data,Use of Lab records | 2 | |
| 7 | Semimicro analysis and Microanalysis, advantages and disadvantages | | |
| 8 | Application of common ion effect in precipitation and separation of ions | 4 | |
| 9 | Inter group separation techniques | 4 | |

| | | | |
|---|---|---|---|
| **II** | **Qualitative Inorganic Analysis (Micro Analysis)** | **48** | 4,5, 6 |
| 1 | Studies of the reactions of the following basic radicals with a view to their identification and confirmation:<br>Lead, Copper, Bismuth, Cadmium, Tin, Antimony, Ferrous, Ferric ions, Aluminium, Chromium,<br>Zinc,Manganese,Cobalt,Nickel,Calcium,Strontium,Barium,Magnesium ,<br>Potassium and Ammonium ions/radicals | 12 | |
| 2 | Studies of the reactions of the following acid radicals with a view to their identification and confirmation:<br>Carbonate, Sulphide, Nitrite, Nitrate, Fluoride, Chloride, Bromide, Iodide , Borate, Acetate, Oxalate, Chromate, Phosphate and Sulphate anions. | 12 | |
| 3 | Systematic qualitative analysis by **microscale methods** of salt mixtures containing two acidic and two basic radicals from the above list (more than one interfering radical should be avoided). | 30 | |
| **III** | **Inorganic Preparations**<br><br>Preparations of<br>i)Potash alum<br>ii) Hexamine cobalt Chloride<br>iii) Tetramine copper Sulphate<br>iv) Mohr's salt<br>v) Microcosmic salt<br>vi) Sodium cobalti nitrate<br>vii) Sodium nitro prusside<br>vii) Manganese phthalocyanin<br>ix) Potassium trioxalatochromate<br>x) Potassium trioxalatoferrate | **20** | 4,5, 6 |
| IV | **Introduction to Chromatographic Separation techniques (No ESE)** | **4** | 8 |
| 1 | Demonstration of Paper chromatography | 2 | |
| 2 | Demonstration of Thin layer chromatography | 2 | |

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**SEMESTER V**
**Core Course-VIII**
**LAB COURSE II**
**INORGANIC VOLUMETRIC ANALYSIS**
**(ESE at V Semester)**

**Time 3Hrs** **Marks 80**

| | |
|---|---|
| Semester | V |
| Course | Core Course-VIII, Lab Course II |
| Course name | **INORGANIC VOLUMETRIC ANALYSIS** |
| Course Code | **CH1544** |
| Credit | 3 |
| Hours | 5 hours/week (90Hrs) |
| Lecture-Tutorial-Lab | 0-0-5 |

| CO No. | **COURSE OUTCOME** *Upon completion of this course, the students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Develop skill in selecting, primary and secondary standards | U | PSO1 |
| 2 | Develop skill in weight calculation of primary standards weighing by electronic balance, making of solutions of definite strength (standard solutions) | A | PSO2<br>PSO8 |
| 3 | Use sophisticated glass wares, calibrate apparatus and develop skill in keen observation , prediction and interpretation of results | A | PSO1 |
| 4 | Perform volumetric titrations under acidimetry-alkalimetry, permanganometry, dichrometry, iodimetry-iodometry,cerimetry, argentometry and complexometry | A | |
| 5 | Compare the advantages and disadvantages of different volumetric techniques | U | |
| 6 | Practice Punctuality and regularity in doing experiments and submitting Lab records | A | |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **I** | **Preparation of standard solutions** | **6** | |
| 1 | Calculation of mass of a primary standard substance and preparing its standard solution (use of constant boiling hydrochloric acid and Analytical Grade Reagents is recommended) | **2** | |
| *2* | Preparation of a solution of definite strength by Dilution techniques | **2** | |
| 3 | Preparation of carbonate free sodium hydroxide. | **2** | |
| **II** | **Inorganic Volumetric analysis-( one burette titration )** | | |
| **(a)** | ***Acidimetry and alkalimetry*** | **25** | |
| 1 | Standardisation of HCl using Analytical Grade $Na_2CO_3$ | **3** | |
| 2 | Titrations of Strong acid (HCl, $HNO_3$ and $H_2SO_4$) by strong bases (NaOH, KOH) | **8** | |
| 3 | Strong base (NaOH, KOH)– weak acid (Oxalic acid) | **5** | |
| 4 | Strong acid –(HCl, $HNO_3$ or $H_2SO_4$) by weak base ($Na_2CO_3$ solution) | **5** | |
| 5 | Determination of $Na_2CO_3$ and $NaHCO_3$ in a mixture by indicator method | **2** | |
| 6 | Estimation of $NH_3$ in an ammonium salt by direct and indirect methods | **2** | |
| ***(b)*** | ***Permanganometry*** | 24 | |
| 1 | *Standardisation of Potassium permanganate using A.R Oxalic acid/Mohr's salt* | 3 | |
| 2 | Estimation of Ferrous iron | 3 | |
| 3 | Estimation of Oxalic acid | 3 | |
| 4 | Estimation of Hydrogen peroxide | 3 | |
| 5 | Estimation of Calcium | 4 | |
| 6 | Estimation of Nitrite | 3 | |
| 7 | Estimation of $MnO_2$ in pyrolusite | 5 | |
| ***(c)*** | ***Dichrometry*** | *9* | |
| 1 | Determination of Ferrous iron using internal & external indicator | 4 | |
| 2 | Determination of Ferric iron after reduction with $SnCl_2$. | 5 | |
| **(*d*)** | ***Cerimetry*** | 4 | |
| 1 | Standardisation of ceric ammonium sulphate with Mohr's salt. | 2 | |
| 2 | Determination of oxalic acid using ceric ammonium sulphate. | 2 | |
| ***(e)*** | ***Iodimetry &Iodometry*** | **9** | |
| 1 | Standardisation of thiosulphate using $KIO_3$ | 3 | |
| 2 | Standardisation of iodine using thiosulphate | 3 | |
| 3 | Determination of copper in copper sulphate | 3 | |
| ***(f)*** | *Precipitation titration* | *3* | |
| | Determination of chloride in neutral medium | 3 | |

| | | | |
|---|---|---|---|
| *(g)* | ***Complexometry*** | *10* | |
| 1 | Standardisation of EDTA solution with ZnSO4 | 3 | |
| 2 | Determination of Zinc, using EDTA | 2 | |
| 3 | Determination of Magnesium | 2 | |
| 4 | Determination of permanent and temporary hardness of water using standardized EDTA | 3 | |

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**LAB COURSE III**

## PHYSICAL CHEMISTRY EXPERIMENTS

**(ESE at V Semester)**

**Time 3Hrs**

**Marks 80**

**Instructions for use of computer softwares and programmes in the physical chemistry experiments**

1.Computer software (Excel) is to be used for plotting graph or calculations.
2. Spread sheet program can be used for determining Equivalence point in potentiometric and conductometric titrations .
3. Data analysis of kinetic experiments using spreadsheet program (determination of rate constant)
4.Plot scatter diagram ( wherever applicable in physical experiments)

| | |
|---|---|
| Semester | V |
| Course | Core Course-IX, Lab Course III |
| Course name | **PHYSICAL CHEMISTRY EXPERIMENTS** |
| Course Code | **CH1545** |
| Credit | 2 |
| Hours | 4 hours/week (72Hrs) |
| Lecture-Tutorial-Lab | 0-0-4 |

| CO No. | **COURSE OUTCOME**<br>*Upon completion of this course, the students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Develop Scientific outlook and approach in applying principles of physical chemistry in chemical systems/reactions | U | PSO1 |
| 2 | Use computational methods for plotting graph | A | PSO2/PSO8 |

| | | | |
|---|---|---|---|
| 3 | Desribe systematic procedures for physical experiments | U | PSO1 |
| 4 | Acquire Instrumentation skill in using conductometer, potentiometer, refractometer, stalagmometer and Ostwald's viscometer. | U | PSO3 |
| 5 | Compare theory with experimental findings | A | PSO1& PSO2 |
| 6 | Practice Punctuality and regularity in doing experiments and submitting Lab records | A | |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **I** | **Conductometry** | **12** | 1-7 |
| 1 | Determination of cell constant | | |
| 2 | Conductometric titration of NaOH using HCl | | |
| **II** | **Potentiometry** | **8** | 1-7 |
| 1 | Potentiometric titration of $Fe^{2+}$ *versus* $Cr_2O_7^{2-}$ | | |
| 2 | Potentiometric titration of $KMnO_4$ *versus* KI | | |
| 3 | Potentiometric titration of HCl *versus* NaOH using quinhydrone electrode | | |
| **III** | **Phenol-water (Binary liquid systems)** | **12** | 1-7 |
| 1 | Critical solution temperature of phenol –water system | | |
| 2 | Influence of KCl(impurity) on the miscibility temperature of phenol-water system .Determination of concentration of given KCl solution | | |
| **IV** | **Transition temperature depression methods** | **12** | 1-7 |
| 1 | Determination of transition temperature of a salt hydrate. | | |
| | Determination of Kt of salt hydrate | | |
| 2 | Determination molar mass of a solute using transition point depression method | | |
| **V** | **Kinetics** | **4** | 1-7 |
| | Kinetics of hydrolysis of an ester (methyl acetate/ ethyl acetate) | | |
| **VI** | **Surface tension** | **4** | 1-7 |
| 1 | Determination of Surface tension of any three liquids | | |
| 2 | Surface tension of binary mixtures and determination of concentration of an unknown mixture | | |
| **VII** | **Viscosity** | **4** | 1-7 |
| 1 | Determination of viscosity of any three liquids | | |
| 2 | Viscosity of binary mixtures and determination of concentration of an unknown mixture | | |
| **VIII** | **Refractice index experiments** | **4** | 1-7 |
| 1 | Determination of refractive indices of any three liquids | | |
| 2 | Refractive indices of KCl solutions of different concentrations and determination of concentration of unknown KCl solution | | |
| **IX** | **Heat of neutralization** | **4** | 1-7 |

| | | | |
|---|---|---|---|
| | Determination of water equivalent of Calorimeter and heat of neutralization of strong acid and strong base | | |
| **X** | **Partition experiments** | **8** | 1-7 |
| | Partition coefficient of iodine between $CCl_4$ and $H_2O$ or Partition coefficient of ammonia between $CHCl_3$ and $H_2O$ | | |

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**LAB COURSE IV ORGANIC CHEMISTRY EXPERIMENTS**

**(ESE at VI Semester)**

**Time 3Hrs** **Marks 80**

| | |
|---|---|
| Semester | VI |
| Course | Core Course-XIII, Lab Course IV |
| Course name | **ORGANIC CHEMISTRY EXPERIMENTS** |
| Course Code | CH1644 |
| Credit | 3 |
| Hours | 5 hours/week (90 Hrs) |
| Lecture-Tutorial-Lab | 0-0-5 |

| CO No. | **COURSE OUTCOME**<br>*Upon completion of this course, the students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Develop curiosity in systematically analyzing organic compounds | A | PSO1 |
| 2 | Differentiate and identify organic compounds by their characteristic reactions towards standard reagents | U | PSO10 |
| 3 | Confirm their findings by preparing solid derivatives, and thus understand reliability of experimental results | A | PSO2 |
| 4 | Determine physical constants of organic compounds | A | PSO3 |

| | | | |
|---|---|---|---|
| 5 | Separate organic compounds by TLC/paper/column chromatographic techniques | A | PSO3 |
| 6 | Prepare soaps | A | PSO18 |
| 7 | Apply the principles and techniques in organic chemistry, thereby developing skill in designing an experiment to synthesize and purify organic compounds | A | PSO18 |
| 8 | Practice systematic scientific procedure and prepare adequate report of them | A | PSO16 |
| 9 | Understand the chemistry behind organic reactions | A | PSO10 |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **I** | **Detection of Elements** | **3** | |
| | Lassaign's test for Nitrogen, Sulphur and Halogen | | |
| **II** | **Solubility Tests** | **5** | 2 |
| 1 | Classification of compounds into water soluble/insoluble | | |
| 2 | Classification of compounds into ether soluble/insoluble | | |
| 3 | Solubility in $Na_2CO_3$ | | |
| 4 | Solubility in NaOH | | |
| 5 | Solubility in HCl | | |
| **III** | **Tests for Aliphatic and Aromatic compounds** | **2** | 2 |
| | (i)Ignition test (ii)Nitration test | | |
| **IV** | **Tests for saturated and unsaturated compounds** | **2** | 2 |
| | (i)Oxidation (ii) Bromination | | |
| **V** | **Tests to distinguish between following compounds** | **6** | 2 |
| 1 | monocarboxylic acid and dicarboxylic acid | | |
| 2 | primary,secondary and tertiary amines | | |
| 3 | monoamide and diamide | | |
| 4 | aldehyde and ketone | | |
| 5 | reducing and non reducing sugars | | |
| 6 | monohydric phenols and dihydric phenols | | |
| **VI** | **Reactions of common functional groups using known organic compounds**. | **6** | 6 |
| **VII** | **Systematic qualitative analysis with a view to characterization of the following functional groups** | **30** | 6 |

| | | | |
|---|---|---|---|
| 1 | Halo compounds :chlorobenzene, benzyl chloride, | | |
| 2 | Phenols: phenol, *o* ,*m* ,*p* -cresols, naphthols, resorcinol | | |
| 3 | Aldehydes and ketones: benzaldehyde, acetophenone, benzophenone | | |
| 4 | Carboxylic acids: benzoic, phthalic, cinnamic and salicylic acids | | |
| 5 | Esters: ethyl benzoate, methyl salicylate | | |
| 6 | Amides: benzamide, urea | | |
| 7 | Anilines: aniline, *o,m, p* - toluidines, dimethylaniline | | |
| 8 | Nitro compounds: nitrobenzene, *o*- & *p*- nitro toluene | | |
| 9 | Poly nuclear hydrocarbons: naphthalene, anthracene | | |
| 10 | Reducing and non reducing sugars: glucose and sucrose | | |
| **VIII** | **Preparation of Organic Compounds.** | **16** | 5&6 |
| 1 | Halogenation :Bromination of acetanilide | | |
| 2 | Nitration of Acetanilide or nitrobenzene | | |
| 3 | Oxidation of benzaldehyde/Toluene/Benzyl chloride | | |
| 4 | Acetylation of salicylic acid or aniline<br>Benzoylation of phenol or aniline | | |
| 5 | Hydrolysis of ethyl acetate and benzamide | | |
| **IX** | ***Preparation of Soap** | | |
| **X** | **Chromatography** | **10** | 4 |
| 1. | **TLC of simple organic compounds (using TLC sheets) | | |
| 2 | *Paper chromatographic separation of mixture of inks and sugars | | |
| 3 | *Column chromatographic separation of a mixture of dyes | | |
| **XI** | ***Organic estimations** | **4** | 8 |
| 1 | Estimation of phenol | | |
| 2 | Estimation of Aniline | | |
| **XII** | **Determination of physical constants | **3** | 3 |
| XIII | Steam distillation –Extraction of essential oil from citrus fruits/eucalyptus leaves (NOT FOR ESE) | **3** | 4 |

** **Experiments under X or XII are compulsory but only one is expected for a batch.**

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**SEMSTER VI Core Course-XIV**

## LAB COURSE V GRAVIMETRIC EXPERIMENTS

**(ESE at VI Semester)**

| | |
|---|---|
| Semester | VI |
| Course | Core Course-XIV, Lab Course V |
| Course name | GRAVIMETRIC EXPERIMENTS |
| Course Code | CH1645 |
| Credit | 2 |
| Hours | 4 hours/week (72Hrs) |
| Lecture-Tutorial-Lab | 0-0-4 |

| CO No. | COURSE OUTCOME<br>*Upon completion of this course, the students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Understand precipitation techniques in quantitative context | U | PSO1 |
| 2 | Appreciate the application of silica crucible and sintered crucible in gravimetry | A | PSO2<br>PSO8 |
| 3 | Practice technique of making, diluting solutions on quantitative basis | A | PSO1 |
| 4 | Realise the factors affecting precipitation/crystallisation | A | PSO1 |
| 5 | Take precautionary measures in filtration , drying and incineration of precipitates | U | PSO3 |
| 6 | Understand the principle of colorimetry to estimate $Fe^{3+}$ and ammonia | A | PSO1& PSO2 |
| 7 | Practice Punctuality and regularity in doing experiments and submitting Lab records | A | PSO18 |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **I** | **Precipitation and Filtration Techniques** | **10** | 1,2 |
| 1 | True solution , Colloids, Precipitates | | |
| 2 | Saturated and super saturated solutions | | |
| 3 | Solubility product and common ion effect | | |
| 4 | Precipitating agents | | |

| | | | |
|---|---|---|---|
| 5 | Co-precipitation and post precipitation | | |
| 6 | Washing of precipitate based on principle of solvent extraction | | |
| 7 | Filtration using Whatmann Filter paper | | |
| 8 | Desiccating agents and use of desiccators and vacuum desiccators | | |
| 9 | Incineration in silica crucible | | |
| 10 | Use of sintered crucible and its advantages and limitations | | |
| **II** | **Gravimetric Estimations** | | |
| **A** | **Estimations using silica crucible** | **30** | 1,2 |
| 1 | Estimation of water of crystallization in hydrated Barium chloride | | |
| 2 | Estimation of Barium as Barium sulphate | | |
| 3 | Estimation of sulphate as Barium sulphate | | |
| 4 | Estimation Iron as $Fe_2O_3$ | | |
| 5 | Estimation Calcium as $CaCO_3$ | | |
| 6 | Estimation Aluminium as $Al_2O_3$ | | |
| 7 | Estimation Magnesium as $Mg_2P_2O_7$ | | |
| **B** | **Estimations using sintered crucible** | **20** | 1,2 |
| 1 | Magnesium as oxinate | | |
| 2 | Nickel as nickel dimethyl glyoximate | | |
| 3 | Copper as copper thiocyanate | | |
| 4 | Silver as silver chloride | | |
| **II** | **Colorimetry** | **12** | 3 |
| 1 | Determination of $Fe^{3+}$ using thiocyanate | | |
| 2 | Determination of ammonia using Nessler's reagent. | | |

**Textbooks**


1. A.I.Vogel, "A text book of Qualitative Analysis including semi micro methods" Longmans.
2. V.V.Ramanujam, "Semi micro Qualitative Analysis"
3. E.S.Gilreath "Qualitative Analysis using semi micro method" Mc Graw Hill
4. A.I.Vogel, "A text book of Qualitative Inorganic Analysis" Longmans
5. A.I.Vogel, "Elementary Practical Organic Chemistry" Longmans
6. J B Yadav,Advanced Practical Physical Chemistry, Goel ,Publishing House


**For Further Reading**


1. Day and Raman, "Laboratory Manual of Organic Chemistry".
2. B.Viswanathan and P.S Raghavan , "Practical Physical Chemistry" 2005 Edn. Viva Books (Pvt.Ltd)
3. F.G Mann and B.C Saunders, "Practical Organic Chemistry" 4th Edn, Orient Longmann
4. A.Findlay, "Practical Physical Chemistry" Creative Media
5. R.C.Das and E.Behara, "Experimental Physical Chemistry", Tata Mc Graw Hill
6. N.K.,Vishnu, "Advanced practical organic chemistry" Vikas publishing house, New Delhi

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**

**2020 Admission onwards**

| | |
|---|---|
| Semester | V-VI |
| Course | **PROJECT COURSE** |
| Course name | **PROJECT** |
| Course Code | **CH1646** |
| Credit | 4 |
| Marks | 100 ( No CE marks) |
| Lecture-Tutorial-Lab | 0-0-2 |

| **CO No.** | **COURSE OUTCOME**<br>*Upon completion of this course, the students* | **Cognitive Level** | **PSO No.** |
|---|---|---|---|
| 1 | Develop an aptitude for research in chemistry | U,A | PSO1 |
| 2 | Practice research methodology and literature search | A | |
| 3 | Critically choose appropriate research topic and presentation | A | PSO2<br>PSO8 |

**GUIDELINES FOR PROJECT COURSE ( Course Code CH1646)**

- The board of examiners can decide the scheme of evaluation of project , study tour report and viva voce
- Topics of chemical interest can be selected for the project. Project is to be done by a group not exceeding 5 students on approval by the teacher in charge.
- Every student should submit typed (A4 paper, 12 Font, 1.5 Space, 20- 30 pages), spirally bind
  project report duly attested by the supervising teacher and the Head of the Department on the day of practical examination before a board of two Examiners for ESE.
- The viva-voce based on the project is conducted individually.
- Project topic once chosen shall not be repeated by any later batches of students.
- List of projects submitted year wise is to be maintained in a register and submitted before the examiners if necessary.

. .**The project report may contain the following sections**

1. Preliminary (Title page, declaration, certificate of the supervising teacher, content etc.)
2. Introduction with relevant literature review and objective
3. Materials and Methods
4. Results
5. Discussion
6. Conclusion / Summary
7. References

**STUDY TOUR AND FACTORY VISIT**

Students are directed to

- Visit at least one chemical factory preferably with in the state of Kerala.
- Submit scientifically prepared hand written study tour report along with photographs of candidate at the places of visit for ESE on the day of the examination of project evaluation.

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**

**2020 Admission onwards**
**OPEN COURSE FOR OTHER MAJORS**

| | |
|---|---|
| Semester | V |
| Course | Open Course |
| Course name | **CHEMISTRY AND ITS APPLICATIONS** |
| Course Code | CH 1551.1 |
| Credit | 2 |
| Hours | 54 hours |
| Lecture-Tutorial-Lab | 2-0-0 |

| CO No. | COURSE OUTCOME<br>*Upon completion of this course, students* | Cognitive level | PSO |
|---|---|---|---|
| 1 | Appreciate the history of evolution of science | U | PSO1 |
| 2 | Develop curiosity and scientific attitude towards the application of chemistry in daily life | C | PSO1 |
| 3 | Appraise the current development in Chemistry and contribution of chemistry for sustainable development | E | PSO1 |
| 4 | Identify the common ingredients of house hold synthetic products | U | PSO 8 |
| 5 | Classify chemicals according to their uses | U | PSO3 |
| 6 | Critically choose cosmetics and cleansing agents for daily use | E | PSO15 |
| 7 | Adopt safer and healthier life skills in harmony with nature | A | PSO21 |

| **MODULE** | **COURSE DESCRIPTION ( No Chemical structure required)** | **Hrs** | CO No. |
|---|---|---|---|
| **1** | **Evolution of Chemistry as a discipline of science** | **9** | 1,2 |
| 1.1 | Evolution of Chemistry - ancient speculations on the nature of matter, early form of chemistry-alchemy. | 1 | |
| 1.2 | Chemical revolution, Atomic and Molecular Theory | 1 | |
| 1.3 | Comparison of Rutherford's atom model with solar system | 2 | |
| 1.4 | Major contributions of Mendeleev, Michael Faraday and Marie Curie. | 1 | |
| 1.5 | Scope of Chemical Science, branches of Chemistry, Basic idea of interdisciplinary areas involving Chemistry | 1 | |

| | | | |
|---|---|---|---|
| **2** | **Chemistry for energy production** | **9** | 3 |
| **2.1** | Electrochemical cell-cathode and anode, Daniel cell, Dry cell | **2** | |
| 2.2 | Fuels: Definition and classification of fuels, characteristics of a good fuel, Combustion, calorific value, Wood, coal, Classification based on carbon content | 2 | |
| 2.3 | Petroleum, Origin, Petrol- Diesel, Flash point. Aviation fuels | 2 | |
| 2.4 | Natural gas, biogas, and LPG- composition<br>Pollution due to burning of fossil fuels | 2 | |
| 2.5 | Solar energy and solar cells ( applications only) | 1 | |
| **3** | **Vitamins , hormones, enzymes and nucleic acids** | **9** | 2 |
| 3.1 | Vitamins: Vitamin A, $B_2$, C, D, E and K<br>source, function and deficiency diseases | 3 | |
| **3.2** | Hormones: Insulin and its function, Thyroid hormones, Iodine deficiency condition | 2 | |
| **3.3** | Enzymes: as Biological catalysts,–<br>Role of enzymes in digestion of food | 2 | |
| **3.4** | Nucleic acids: RNA and DNA, Role of nucleic acids in life process (No structure or chemical reactions) | 2 | |
| **4** | **Chemistry in day today life** | **9** | 3,7 |
| 4.1 | **Food Chemistry**: Food additives, preservatives, anti oxidants, commonly used permitted and nonpermitted food colours -artificial sweeteners-taste enhancers<br>Health effects of fast foods, instant foods, dehydrated foods and junk foods | 2 | |
| 4.2 | **Cosmetics**: talcum powder, lip sticks, nail polish, moisturiser<br>Sun screen lotions and hair dye | 2 | |
| 4.3 | **Cleansing agents**: Soaps- Hard and soft soaps, alkali content-TFM, Detergents and Shampoos. | 1 | |
| 4.5 | **Plastics** : Thermo plastics and thermosetting plastics, Plastic identification codes, biodegradable plastics (PGA,PLA and PHBV) and their applications,<br>Importance of Plastic recycling | 2 | |
| 4.6 | **Pharmaceuticals**: Drugs, classification into analgesics, antacids, antibiotics, antiseptics, disinfectants, anaesthetics, tranquilisers, narcotics and antidepressants-one example | 2 | |
| **5** | **Environmental Chemistry I** | **9** | **2,7** |
| 5.1 | Air pollution: Composition of air, major causes of air pollution, Pollutants in air-carbon monoxide, carbon dioxide, oxides of Nitrogen and sulphur , chlorofluro | 2 | |

| | | | |
|---|---|---|---|
| | carbons- effect of using refirigerators and air conditioners,<br>Particulate matter- Acid rain, Green house effect, ozone layer and its depletion | | |
| **6** | **Environmental Chemistry II** | **9** | 2,7 |
| 6.1 | Water pollution: causes- heat, industrial waste, sewage water, detergents, agricultural pollutants<br>Treatment of industrial waste water- Activated charcoal, Reverse osmosis<br>Quality of drinking water- Indian Standard and WHO standard- Dissolved oxygen- BOD , COD | 6 | |
| 6.2 | Soil pollution: pesticides, fertilizers, Industrial waste, Plastic. | 3 | |

**Reference**


1.T F Giereyn, Cultural boundaries of science) University, Chikago Press, 1999
2 N C Dutta, The Story of Chemistry, University Press

3.MSR Winter, A Consumer's dictionary of cosmetic ingredients, 7th edition, Three Rivers Press, NewYork,2009
4.B K Sharma, Polymer chemistry, Goel Publishing House, Meerut, 1989
5. B K Sharma, Industrial chemistry, 11th edition, Goel Publishing House, Meerut, 2000
6.A K Day,"Environmental chemistry-An Introduction", New Age Publisher, 8th edition
7. B Srilakshmi, Food Science,5th edition, New Age Publishers, NewDelhi,2010
8. Organic Chemistry of Drug action and drug design-L B Silverman, Elsvier,
9. Medicinal Chemistry , An introduction, II nd edition Gareth Thomas, Wiley, India,2011


**UNIVERSITY OF KERALA**
**Model Question Paper First Degree Programme**
**2020 Admission onwards**
**SEMESTER V Course Code CH1551.1**
**OPEN COURSE FOR OTHER MAJORS**
**CHEMISTRY AND ITS APPLICATION**

**SECTION A**
**Answer all questions in one word , each question carry one mark**

1.Name any one interdisciplinary area of chemistry
2.Early form of chemistry is called--------
3.Enzymes are called biological ---------
4. Name the hormone produced byPancrease
5.Alkali content of soap is expressed as ------

6.PGA is a biodegradable plastic. State true or false
7 .Name the main constituent of LPG
8.White lead is a --------
9.Which among DNA and RNA determine heredity ?
10.Night blindness is caused by deficiency of
a)Vitamin A,b)Vitamin C,c)Vitamin.D,d)Vitamin K

## SECTION B

Each Question carries 2 marks. Answer any 8 questions.

11.Give two examples each for enzymes and hormones.
12. How will you distinguish between hard and soft soaps?
13.What are nucleic acids? Give examples.
14.How does acid rain occurs?
15.Define calorific value of a fuel.
16.Suggest a natural way of harvesting solar energy. Explain.
17.How will you classify fuels?
18.Name two petroleum based fuels.
19.How do iodine deficiency affect human beings?
20.What is an electrochemical cell?
21.Name the electrodes in Daniel cell.
22. What is the cause of green house effect?

## SECTION C

Each Question carries 4 marks. Answer any 6 questions.

23. Explain the source and hazards of fly ash and asbestos.
24. Explain briefly soil pollution.
25. Write a note on enzymes.
26. List four different types of drugs
27. Distinguish between antiseptics and disinfectants
28. What are the characteristic of a good fuel?
29. What are the functions and deficiency diseases of Vitamin C, Vitamin D ?.
30. Write a note on Enzymes.
31. Discuss on the health effects of fast food and junk food.

**(4×6 = 24 marks)**

## SECTION D

**Answer any two questions** (15 marks each)

32. a) Discuss on the major contributions of Rutherford .
    b) Differentiate between cathode and anode. Identify the anode and cathode in Dry cell
    c) Chemistry is the central science of many other disciplines.Justify (5x3 = 15 marks)

33. a) Write a note on Dalton's atomic theory.
    b) How do Refrigerators cause air pollution? Explain.

c) Write a note on vitamin deficiency disease. (5x3 = 15 marks)

34. a) What are the 'Three R's of plastic control?
b) What is meant by DNA? Name the sugar unit present in DNA.
c) Write a note on Drugs. (5x3 = 15 marks)

35. a) Explain the cleansing action of soap.
b) What is antibiotic? Give the names of the first antibiotic and the scientist who discovered it.
c) Give an account of the green house effect. (5 x 3 =15 marks)

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**UNIVERSITY OF KERALA**

## OPEN COURSE FOR OTHER MAJORS

**SEMESTER-V CREDIT-2 COURSE CODE-CH1551.2**

| | |
|---|---|
| Semester | V |
| Course | Open Course |
| Course name | **FUNDAMENTALS OF CHEMISTRY AND ITS APPLICATION TO EVERYDAY LIFE** |
| Course Code | CH 1551.2 |
| Credit | 2 |
| Hours | 54 hours |
| Lecture-Tutorial-Lab | 2-0-0 |

| **CO No.** | **COURSE OUTCOME** *Upon completion of this course, students* | **Cognitive Level** | **PSO No.** |
|---|---|---|---|
| 1 | Appreciate the evolution of Science and Chemistry and the early form of chemistry | U | PSO1 |
| 2 | Understand the dvelopement of Chemistry as a discipline and the role of chemistry as a central science | U | PSO1 |
| 3 | Discuss the fundamental properties of atom, structure of atom, classification of elements in to a periodic table | U | PSO3 |
| 4 | Differentiate between simple molecules and giant molecules and the bonding nature | U | PSO11 |
| 5 | Explain different types of bonding and predict stability | U | PSO4 |

| | | | |
|---|---|---|---|
| 6 | Compare properties of graphite and diamond and their structural differences | U | PSO4 |
| 7 | Identify house hold chemicals, their advantages and disadvantages | U | PSO12 |
| 8 | Become aware of chemical hazards and the precautions in handling chemicals | A | PSO12 |
| 9 | Beware of food adulterants | A | PSO12<br>PSO21 |
| 10 | Critically select chemical fertilizers,artificial sweeteners, beverages, and food preservatives | A | PSO21 |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **1** | **Evolution of Chemistry** | **9** | **2** |
| **1.1** | Evolution of Chemistry - ancient speculations on the nature of matter, early form of chemistry -alchemy | 3 | |
| **1.2** | Robert Boyle and the origins of modern chemistry in the latter 1600s - origin of modern chemistry - Antoine Lavoisier and the revolution in chemistry | 3 | |
| **1.3** | Role of Chemistry as a central science connecting Physics, Biology and other branches of science. Basic ideas of interdisciplinary areas involving Chemistry | 3 | |
| **2** | **Atomic structure** | **9** | **2** |
| 2.1 | Atom- model of Dalton- Thomson – Rutherford and Bohr | 3 | |
| 2.2 | Nature of electron proton and neutron – atomic number – mass number- isotopes -state the relative charges and approximate relative masses of a proton, a neutron and an electron | 3 | |
| 2.3 | Description with the aid of diagrams, the structure of simple atoms as containing protons and neutrons (nucleons) in the nucleus and electrons arranged in shells (energy levels-K,L,M etc) (mention only of s, p, d and f orbitals) | 3 | |
| 3 | **Periodic table** | **9** | **2** |
| **3.1** | The Periodic Table - Periodic trends, Group properties - describe the relationship between group number and the ionic charge of an element- | 3 | |
| **3.2** | similarities among the elements in the same group - metallic to non-metallic character from left to right across a period of the Period Table | 2 | |
| **3.3** | Classification into s,p,d, and f block- General Properties of elements in Group I and XVIII using the Periodic | 4 | |

| | | | |
|---|---|---|---|
| | Table, metals, nonmetals, metalloids and inert gases | | |
| **4** | **Structure and properties of materials** | **9** | **5** |
| **4.1** | Elements, compounds and mixtures – elementary idea of ionic bond and covalent bond | 2 | |
| **4.2** | Compare the structure of simple molecular substances, e.g. methane; water, carbon dioxide, iodine, with those of giant molecular substances, e.g. poly(ethene); sand (silicon dioxide); | 4 | |
| **4.3** | Diamond and graphite in order to deduce their properties compa the bonding structures of diamond – graphite, electrical conductivity | 3 | |
| **5** | **Chemicals used in everyday life.** | **9** | **8** |
| **5.1** | Household materials – Major chemical ingredients (No structural formula and preparation needed), : Match Box- Soap- detergent— cooking gas – tooth paste – shampoo- hair dye- nail polish- whitener-moth balls, house hold bleach | 4 | |
| **5.2** | method of action and possible hazards/toxicity of | 3 | |
| **5.3** | Explosive chemicals, propellants –fire crackers. | 2 | |
| **6** | **Chemicals in food and beverages** | **9** | **9** |
| **6.1** | Important chemical ingredients/ taste makers used in packed food - soft drinks - and its health hazards ,Chemicals in food production | 3 | |
| **6.2** | fertilizers used in natural sources - Fertilizers urea, NPK and Super phosphates - uses and hazards. | 2 | |
| **6.3** | Adulterants in milk, ghee, oil, coffee powder, tea, asafoetida, chilli powder, pulses and turmeric powder - identification | 2 | |
| **6.4** | artificial sweeteners - food preservatives | 2 | |

**UNIVERSITY OF KERALA**

**Model Question Paper First Degree Programme**

**2020 Admission onwards**

**SEMESTER V Course Code CH1551.2 Credit 2**

**OPEN COURSE FOR OTHER MAJORS**

**FUNDAMENTALS OF CHEMISTRY & ITS APPLICATION TO EVERYDAY LIFE**

**Time: Three Hours** **Maximum Marks : 80**

## SECTION A

**(Answer in a word / sentence) Answer all questions**

1. Name the early form of chemistry
2. Who is the father of modern chemistry?

3. What is superphosphate?
4. $^{1}H$ , $^{2}H$ and $^{3}H$ are called --------of hydrogen
5. Diamond is chemically ----(carbon, gold, Silicon, glass)
6. What is main constituent of LPG ?
7. Mercury is a liquid ----(metal, nonmetal, metalloid, none of the above)
8. Silica is the chemical name of (sand, soap,silver, carbon)
9. Artificial sweeteners and ------- ---- are common in junk food.
10. What is periodicity?

## SECTION B

**Each question carries 2 marks (Short answer type).**
**Answer any eight questions .**

11. Name any two Toxic Chemicals in Cosmetics
12. Obtain the electron configuration for (a) N; (b) F.
13. Explain Hund's rule of maximum multiplicity with an example.
14. Define electron affinity, explain with an example.
15. Which of the following elements Li, Be, B, C, N, O, F and Ne are metals?
16. Explain Bohr model of atom.
17. Why is the electronegativity value of most noble gases equal to zero?
18. What are the Health Effects of Drinking Soda?
19. Which do you expect to have more metallic character, Lead (Pb) or Tin (Sn)
20. What is a Match Head of match stick made of?
21. Explain why graphite conducts electricity whereas diamond doesn't.
22. Is the reactivity of group I metals increasing or decreasing down the group? Explain why?

( 2×8 = 1

## SECTION C

Each question carries **4 marks** (Short essay type)
Answer any six **questions**

23. Explain the colour of firecrackers.
24. What is the difference between covalent and ionic bonding?
25. What are periods and groups in the periodic table? What is periodicity?
26. What are adulterants.
27. How is Thomson's model of the atom different from Dalton's model of atom?
28. What's the difference between an oxidation number and an ionic charge?
29. Explain the health hazards associated with drinking soft drinks?

30. How can metallic character change across a period?

31. Describe clearly the link between increasing effective nuclear charge across a period and the changes in van der Waals radius.

## SECTION D

**Each question carries 15 marks ( essay type) Answer any two questions.**

32. a.Explain about the pH changes of aqueous solutions of elements in the third period as the period is crossed.
b. Explain how these changes are directly related to the changes in effective nuclear charge across the period.
c. Describe the metallic character of elements in a period. (5x3 marks)

33. a.Explain the role of some chemicals in household items. (8 marks)
b.Write a short note on food adultration. (7 marks)

34. a.Write a short note on the uses and hazards of fertilisers. (8 marks)
b.Draw the structure of carbon and sodium (shell model) ( 7 marks)

35. a. Draw the structures showing shapes of methane, water and carbon dioxide (8 marks)
b.compare the bonding structures of diamond – graphite. (7marks)

**UNIVERSITY OF KERALA**

**OPEN COURSE FOR OTHER MAJORS**

2020 Adimission onwards

| | |
|---|---|
| Semester | V |
| Course | Open Course |
| Course name | **ENVIRONMENTAL CHEMISTRY** |
| Course Code | CH 1551.3 |
| Credit | 2 |
| Hours | 54 hours |
| Lecture-Tutorial-Lab | 2-0-0 |

| **CO No.** | **COURSE OUTCOME** *Upon completion of this course, students* | **Cognitive Level** | **PSO No.** |
|---|---|---|---|
| 1 | Discuss the structure and composition of the atmosphere | U | PSO14 |
| 2 | Identify,Realise and enlist the causes of pollution to water, soil and air | U | PSO14 |
| 3 | Become aware of environmental issues and its effect to man and other living beings | U | PSO12 |
| 4 | Review major environmental disasters and suggest controlling and preventive measures | U | PSO12 |
| 5 | Discuss the laws of environmental protection | U | PSO21 |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| 1 | **Environmental Components**<br>Structure and composition of the, Atmosphere, hydrosphere, biosphere and Lithosphere – composition of atmosphere | 9 | 1,2,3 |
| 2 | **Water pollution**<br>Sources, its effect and control; Sampling and measurement of water quality and their analysis, water quality standards, BOD and COD Hard water – soft water Eutrophication and restoration of lakes. | 9 | 1,2,3 |
| 3 | **Air Pollution**<br>Types and sources of air pollution, Common Air Pollutants - Effects of air pollution; Smog – ozone layer depletion<br>green house effect – acid rain | 9 | 1,2,3 |
| 4 | **Soil Pollution**<br>Sources, types, effects and control of: Land pollution, Marine pollution, Thermal Pollution and Radioactive pollution. Waste separation, storage and disposal ; Waste Reduction, Recycling and Recovery of materials.Plastics and their misuses. | 9 | 1,2,3 |
| 5 | **Major environmental disasters**<br>Major environmental disasters - mercury poisoning in Minamata, Japan, Itaiitai disease due to cadmium poisoning in Japan - Love Canal toxic waste site, Seveso disaster chemical plant explosion - Bhopal disaster - Chernobyl incident | 9 | 4 |
| 6 | **Major environmental laws:**<br>Environment (Protection Act) – The Air (Prevention and control of pollution) Act – The water (Prevention and control of pollution) Act – The wild life protection Act – Forest conservation Act – The Ozone Depleting Substances (Regulation and Control) Rules – The Plastic Waste (Management and Handling) Rules - Rio declaration- Montreal protocol, Kyoto protocol Introduction to Green chemistry (elementary ideas only) | 9 | 5 |

**Reference**


1. Banerji, K Sameer"Environmental Chemistry", ISBN - 9788120315761.
2. K. De "Environmental Chemistry - An introduction" New Age International (P)Ltd.,2017
3. B. K. Sharma "Air Pollution", Goel Publishing House
4. V. K. Ahluwalia "Environmental Chemistry", books.google.co.in, 2017
5. G.W. vanLoon and S. J. Duffy "Environmental Chemistry: A Global Perspective"
6. S.K.Mohanty, Environment and Pollution Laws, Universal Law Publishing Co. (P)Ltd

**UNIVERSITY OF KERALA**
**Model Question Paper for**
**B.Sc Chemistry Programme**
**OPEN COURSE FOR OTHER MAJORS**
**Semester V Course Code CH1551.3 Credit -2**
**ENVIRONMENTAL CHEMISTRY**

**Time: 3 hours**
**Marks: 80**

## SECTION A

**Answer all questions** (Each question carries 1 mark)

1. What you meant by Triple R in waste management ?.
2. What type of pollution causes acid rain?
3. What are the misuses of plastics?
4. What are the three major man made sources of air pollution?
5. What kind of materials are discharged into the seas?
6. What increases the amount of carbon dioxide in the atmosphere?
7. Explain the action of zeolites on hard water.
8. What are freons?
9. Define pollution
10. What is fly ash?

## SECTION B

**(short answer type)** (Answer any 8 questions, Each answer carries 2 mark)

11. How is pollution related to acid rain?
12. How does ocean pollution affect sea animals?
13. What are the main concepts of Green Chemistry
14. Write short note on Radioactive pollution
15. Discuss the major composition of earth's atmosphere 16. Write about the cause and consequence of Chernobyl incident
17. What is BOD and COD?
18. What causes radioactive pollution?
19. Distinguish between Hard water and soft water.
20. What is the goal of Forest Conservation Act?
21. What is the Greenhouse effect and what is its cause? 22. What are the types of air pollutants ? **(2×8 = 16)**

## SECTION C

**(Short essay type)** each question carries **4**marks. Answer **any**

23. Write short note on volatile organic compounds.
24. How can thermal pollution be prevented?
25. How do you control Radioactive pollution?
26. What is smog? How does smog arise?
27. What is Eutrophication
28. Write a note on Rio-Declaration.
29. Explain the various layers of the Atmosphere
30. What is Air Pollution? How can air pollution be minimized?
31. Briefly explain about the components of atmosphere.

## SECTION D

Answer **any 2** from the following. Each question carries **15** marks

32. (a) Explain Hardness of water and the different types. (5 marks)
    (b) Discuss about the various sources of water pollution. (5 marks)
    (c) What are the control measures for water pollution ? . (5 marks)
33. (a) Write short note on causes and problems of ozone layer depletion?
    (b) Explain the various types of smog.
    (c) Discuss the Ozone Depleting Substances (Regulation and Control) Rules
34. (a) Explain thermal pollution
    (b) Discuss about plastics and their misuses
    (c) Discuss about Chernobyl disasters
35. (a) Discuss about green chemistry
    (b) Explain Montreal protocol and Kyoto protocol
    (c) The water (Prevention and control of pollution) Act (15 × **2= 30)**

**UNIVERSITY OF KRALA**

**SYLLABUS FOR B.Sc. CHEMISTRY**

**FIRST DEGREE PROGRAMME**

**2020 Admission Onwards**

# ELECTIVE COURSES

| | |
|---|---|
| Semester | V1 |
| Course | Elective Course |
| Course name | **SUPRAMOLECULAR, NANO PARTICLES AND GREEN CHEMISTRY** |
| Course Code | **CH1651.1** |
| Credit | 2 |
| Hours | 54 hours |
| Lecture-Tutorial-Lab | 2-0-0 |

| **CO No.** | **COURSE OUTCOME**<br>*Upon completion of this course, students* | **Cognitive Level** | **PSO No.** |
|---|---|---|---|
| 1 | Become aware of pollution caused by industries | U | PSO13 |
| 2 | Recognise the necessity of green approaches to protect nature | R | PSO14 |
| 3 | Discuss about sustainable development and logical use of natural resourses | U | PSO14 |
| 4 | Motivated to more ecofriendly life style | A | PSO21 |
| 5 | Realises the importance of microscsale approaches and nano material research | U | PSO13<br>PSO21 |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **1** | **Green Chemistry-I** | **9** | **1-5** |
| 1.1 | Role of Chemical Industries in polluting the environment | 1 | |
| 1.2 | Limitations of conventional waste management and pollution prevention-birth of green chemistry | 2 | |
| 1.3 | introduction to the principles of green chemistry-atom economy calculation(simple reactions) | 2 | |
| 1.4 | -production of Ibuprofen-less hazardous chemical syntheses, designing safer chemicals | 2 | |
| 1.5 | Bhopal gas tragedy- new greener syntheses, safer solvents and auxiliaries ionic liquids-super critical fluids CO2 and H2O, advantages of SCFs | 2 | |
| **2** | **Green Chemistry-II** | **9** | **1-5** |
| 2.1 | Design for energy efficiency-principle of microwave oven, microwave assisted organic syntheses, simple examples- | 2 | |
| 2.2 | renewable feedstock- biodiesel, preparation, advantages | 2 | |
| 2.3 | catalysis, green catalysts- inherently safer chemistry for accident prevention | 2 | |
| 2.4 | Green chemistry practices in research, educational and commercial laboratories- lab safety signs-introduction to micro scale experiments. | 1 | |
| **3** | **Chemistry of Nano Materials - I** | **9** | **2** |
| 3.1 | Classifications of nanostructured materials, nano particles; quantum dots, nanowires, ultra – thinfilms multilayered materials. | 2 | |
| 3.2 | Synthesis of nanometre scale particles of colloidal semiconductors such as TiO2, CdS, ZnO, BaTiO3, by wet chemical methods, hydrothermal methods, and pyrolytic or high temperature methods. | 2 | |
| 3.3 | Carbon nanotubes fullerenes and graphene. | 2 | |
| | Synthesis and purification of carbon nanotubes, Singlewalled carbon nanotubes and multiwalled carbon nanotubes, Structure-property relationships. | 3 | |
| **4** | **Chemistry of Nano materials - II** | **9** | **2** |
| 4.1 | Preparation of self-assembled monolayers, core shell nanoparticles and quantum dots. | 2 | |
| 4.2 | Properties of nanoparticles: optical, magnetic, mechanical, thermal and catalytic properties, | 2 | |
| 4.3 | characterisation of nano particles by AFM, STM and | 2 | |

| | | | |
|---|---|---|---|
| | SEM. Applications of nanomaterials: | | |

| | | | |
|---|---|---|---|
| 4.3 | Characterisation of nano particles by AFM, STM and SEM. Applications of nanomaterials: | 2 | |
| 4.4 | Potential uses of nanomaterials in electronics, robotics, computers, sensors, mobile electronic devices, vehicles and transportation. Medical applications of nanomaterials | 3 | |
| **5** | **Molecular recognition** | **9** | **5** |
| 5.1 | The concepts of molecular recognition, host, guest and receptor systems. | **3** | |
| 5.2 | Forces involved in molecular recognition. | **3** | |
| 5.3 | Hydrogen bonding, ionic bonding, p-stacking, vander Waal's and hydrophobic interactions. | **3** | |
| **6** | **Supramolecularchemistry** | **9** | 5 |
| 6.1 | Introduction to molecular receptors-design principles | **2** | |
| 6.2 | Tweezers, Cryptands and Carcerands, Cyclophanes, Cyclodextrins and Calixarenes | **2** | |
| 6.3 | Typical examples Molecular recognition and catalysis-catalysis by cation receptors, anion receptors and cyclophanes | **3** | |
| 6.4 | Molecular recognition in DNA and protein structure | **2** | |

**References**


1. Anastas. P.T.; Warner, J.C.,"Green Chemistry; Theory and Practice", Oxford University Press; Oxford , U.K.,1998.

2. Lancaster,M,"Green Chemistry; An Introductory Text",Royal Society of Chemistry; Cambridge,U K, 2003

3. Rashmi Sanghi and M.M Srivasthava, "Green Chemistry Environment Friendly Alternatives", Narosa Publishing House,2006

4. T.Pradeep, "NANO: The Essentials", 'McGraw-Hill Education'.
5. D. Nasipuri "Stereochemistry of Organic Compounds", Wiley
6. J M Lehn, "Supramolecular Chemistry", V C H.
7. H Vogtle, "Supramolecular Chemistry", W iley.
8. P S Kalsi, J P Kalsi,"Bioorganic, Bioinorganic and supramolecular Chemistry", New Age International

**UNIVERSITY OF KERALA**
**Model Question Paper B.Sc Chemistry Programme**
**2020 Admission Onwards**
**SEMESTER VI Course Code CH1651.1 Credit 2**
**ELECTIVE COURSE**
**SUPRAMOLECULAR, NANO**
**PARTICLES AND GREEN CHEMISTRY**

**Time: 3 Hours** **Maximum marks : 80**

## SECTION A

**Answer all questions. Each question carries 1 mark.**

1. Define atom economy.
2. Write an example of green catalyst.
3. Between an addition and elimination reaction which is having a better atom economy?
4. Name a colloidal semiconductor.
5. Expand SAMS.
6. What is graphene?
7. Name the different allotropes of carbon.
8 . Name any two molecular receptors.
9. What are cryptands?
10. Define π stacking.

## SECTION B

**Answer any eight questions. Each question carries 2 marks.**

11. Write a note on Bhopal Tragedy.
12. Define Carbon efficiency.
13. Explain the limitations of conventional waste management.
14. Give any four lab safety signs with its meaning.
15.Write about the wet method of preparing colloidal semiconductors.
16.What are the magnetic properties of nanoparticles.
17. Briefly describe the catalytic properties of nano materials.
18. Explain the different types of SWCNTs.
19. What are the non-covalent bonds involved in molecular recognition?
20. Define host and guest in supramolecular chemistry.
21. Write a note on Cyclodextrins.
22. What are molecular tweezers?

## SECTION C

**Answer any six questions. Each question carries 4 marks.**

23. What are secondary electrons?
24. Write a note on safer solvents and auxiliaries.
25. Explain ionic liquids.
26. Write a note on biodiesel.
27. Describe the synthesis of quantum dots and mention its optical properties.
28. Explain the preperation of SAMs.
29 Discuss the potential applications of nanomaterials in computers, sensors, and Medical

applications.
30. Discuss the various aspects of molecular recognition involved in the structure of DNA.
31 Write notes on cation and anion receptors.

**SECTION D**

**Answer any two questions. Each question carries 15 marks.**

32. (a)Explain the twelve principles of green chemistry. (10marks)
(b) Explain microwave assisted organic syntheses with an example. (5marks)
33. (a) Explain the principle and working of SEM
(b) Write a note on synthesis and purification of carbon nanotubes.
34. Write short notes on (a) calixarenes (b) Cyclodextrins (c) cyclophanes.
35. Write short notes on(a) molecular recognition(b) preparation biodiesel(c)non bonded interactions.

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**

SEMESTER V1 **COURSE CODE CH1651.2**
ELECTIVE COURSE
**COMPUTATIONAL, COMBINATORIAL AND PHYSICAL ORGANIC CHEMISTRY**

| | |
|---|---|
| Semester | V1 |
| Course | Elective Course |
| Course name | **COMPUTATIONAL, COMBINATORIAL AND PHYSICAL ORGANIC CHEMISTRY** |
| Course Code | **CH1651.2** |
| Credit | 2 |
| Hours | 54 hours |
| Lecture-Tutorial-Lab | 2-0-0 |

| CO No. | COURSE OUTCOME<br>*Upon completion of this course, students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Understand the use of Chemistry related softwares | U | PSO5 |
| 2 | Discuss computational methods and combinatorial synthesis | U | PSO5 |
| 3 | Classify reaction mechanism with suitable examples | U | PSO10 |
| 4 | Understand the role of Thermodynamic functions in the study of Kinetics | U | PSO11 |
| 5 | Correlate structure with reactivity | A | PSO11 |

| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| **1** | **Introduction to Computational Chemistry** | **9** | **1** |
| **1.1** | Web resources in chemistry learning, | 1 | |
| **1.2** | Introduction to structure drawing, spread sheet and chemistry related softwares. | 2 | |
| **1.3** | Approximate methods in Quantum mechanics- Many electron atoms: Self consistent field method. Chemical bonding: | 3 | |
| **1.4** | Perturbation theory and variational principle. MO theory of hydrogen molecule ion. VB theory of hydrogen. Concept of resonance. | 3 | |
| **2** | **Computational Methods** | **9** | **1,2** |
| 2.1 | Brief description of computational methods: ab initio, semi empirical, DFT and molecular mechanics. | 2 | |
| 2.2 | RHF, ROHF &UHF methods Basis sets, STO &GTO | 2 | |
| 2.3 | Z-matrix of simple molecules H2O, CO2 & NH3 | 3 | |
| 2.4 | Common computational and visualization softwares | 2 | |
| 3 | **Combinatorial Chemistry Introduction** | **9** | **2** |
| **3.1** | Early development, what is combinatorial synthesis, library synthesis on resin beads, | 3 | |
| **3.2** | solid phase chemistry, Merrifield peptide synthesis, support for solid phase synthesis, | 3 | |
| **3.3** | parallel synthesis and mix and split library synthesis. | 3 | |
| **4** | **Combinatorial Synthesis** | **9** | **2** |
| **4.1** | Libraries on multipins, libraries on wicks, libraries on | | |

| | | | |
|---|---|---|---|
| | laminar solid phases (no detail study). | | |
| **4.2** | Solution phase library synthesis- eg.-, Hantzsch synthesis of aminothiazole, peptide and nonpeptide libraries( eg. only),. | | |
| **4.3** | Applications of combinatorial chemistry in drug discovery | | |
| **5** | **Introduction to Physical organic chemistry** | **9** | **3-5** |
| **5.1** | Classification of mechanism with suitable examples. Bond breaking mode – Heterolytic, Homolytic and Pericyclic Nature of reaction – | 2 | |
| **5.2** | Substitution, Elimination, Addition, Pericyclic and Rearrangement reactions. Nature of reagent – Nucleophilic, Electrophilic and Free radical. | 2 | |
| **5.3** | Thermodynamic and Kinetic control of reaction. The Hammond postulate (qualitative treatment).<br><br>The thermodynamic functions – ΔH, ΔS and ΔG and their determination from Arrhenius equation. Role of above thermodynamic functions in mechanistic probe of reactions. | 3 | |
| **5.4** | Methods of determining mechanism, Identification of products, Detection of intermediates, Catalytic study, Isotopic labeling, Stereochemical evidence, Kinetic evidence | 2 | |
| **6** | **Correlation of structure with reactivity** | **9** | **3-5** |
| **6.1** | The effect of substrate structure – Differences in mechanism for primary, secondary and tertiary systems. | 2 | |
| **6.2** | The effect of a and ß substitution – the +I and –I effects (Inductive effects of electron releasing and electron withdrawing groups at a and ß positions). | 1 | |
| **6.3** | Substitution of mono and bicyclic (at a and ß positions) aromatic rings (Resonance effects). Hyperconjugate effects. | 2 | |
| **6.4** | Neighbouring group effect nonclassical bridge head | 2 | |
| **6.5** | Steric effects – B-strain, Strain in aliphatic cyclic systems. Steric inhibition of resonance – ortho effect and a-effect, The Hammett equations | 2 | |

**References :**

1. Guy H. Grant and W.Graham Richards, “Computational Chemistry”, OCP(29) 2. Christopher J. Cramer, John Wiley,“Essentials of Computational Chemistry”,
3. Frank Jenson, “Computational Chemistry”.
4. Ira N. Levine,“ Quantum Chemistry”.
5. David Young, “Computational Chemistry A Practical Guide for Applying

Techniques to Real World Problems", Wiley Interscience.

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7. Jerry March "Advanced Organic chemistry", 3rd edition, Wiely International (Indian edn New Delhi) Chapter 6 and 10
8. P S Kalsi," Text of organic Chemistry", Mac million India ltd 1999 Ch 2
9. M K Jain and S C Sharma," Modern Organic Chemistry" , Vishal Publishing Co, 2004, Chapter 3,4, 15

**UNIVERSITY OF KERALA**
**Model Question Paper of BSc Chemistry Programme**
**2020 Admission onwards**
**SEMESTER VI - Course Code CH1651 .2 Credit 2**
**ELECTIVE COURSE**

**COMPUTATIONAL, COMBINATORIAL AND PHYSICAL ORGANIC CHEMISTRY**

**Time: 3 Hours** **Marks : 80**

## SECTION A

**Answer all questions.**
**Each question carries 1 mark.**

**1.** Write Arrhenius expression and explain the terms.
2. What is RHF?
3. What are nucleophilic reagents? Give examples.
4. Name any two structure drawing softwares.
5. Write Hammett equation.
6. Give one example solution phase library synthesis.
7. Write any two examples for polyamide resin.
8. Propene is more stable than ethane. Why?
9. What is combinatorial synthesis?
10. Write any two examples for heterolytic bond breaking reaction.

**1 X 10 = 10 Mark**

## SECTION B

**Answer any eight questions from the following. Each question carries 2 marks**.

11. What are the web resources in learning Chemistry?
12. What is a basis set ?
13. What are the major mechanisms of organic reactions ?
14. Distinguish between STO & GTO.
15. Explain the advantages of combinatorial synthesis.

16. What is meant by electrocyclic reaction. Give one example.
17. What are the applications of combinatorial synthesis.
18. What are multipins used in combinatorial synthesis
19. Explain kinetic requirements of reaction.
20. Explain Hammond postulate.
21. Explain +I and – I effects.
22. Explain isotopic labeling in the study of organic reactions. **2× 8 = 16**

## SECTION C

Answer any six questions from the following. Each question carries 4 marks.

23. Draw the Z matrix of H2O & NH3
24. Why SEM is called parametrisation method
25. How can a eight – member dipeptide library is synthesized ?
26. Explain non-peptide libraries.
27. How are the intermediates detected?
28. Explain substitution reactions of naphthalene.
29. Explain the effect of leaving group in aliphatic substitution reactions.
30. What is self consistent field method.
31. Explain mix and split library synthesis. **6 X 4 = 24 Marks**

## SECTION D

**Answer any two questions from the following. Each question carries**

32. (a)Explain MO theory of hydrogen molecule ion.
(b)Explain VB theory of hydrogen .
10 + 5 = 15 Marks
33. (a)Explain neighboring group participation with examples.
(b)Explain sterric effects and B-strain. 7.5 + 7.5 = 15 Marks

34. (a) How does the structure of substrate affect the aliphatic nucleophilic substitution?
(b) Comment on the effect of substituent on nucleophilic substitution reaction.
7.5 + 7.5 = 15 Marks

35. (a) Write a brief description of methods(a) ab initio(b)DFT (c) molecular mechanics.

5+ 5+ 5 = 15 Marks

**UNIVERSITY OF KRALA**
**SYLLABUS FOR B.Sc. CHEMISTRY**
**FIRST DEGREE PROGRAMME**
**2020 Admission onwards**

| | |
|---|---|
| Semester | V1 |
| Course | Elective Course |
| Course name | **POLYMER CHEMISTRY** |
| Course Code | **CH1651.3** |
| Credit | 2 |
| Hours | 54 hours |
| Lecture-Tutorial-Lab | 2-0-0 |

| **CO No.** | **COURSE OUTCOME** *Upon completion of this course, students* | **Cognitive Level** | **PSO No.** |
|---|---|---|---|
| 1 | Differentiate between Natural and synthetic polymers | U | PSO14 |
| 2 | Understand polymerization process of monomeric units | U | PSO12 |
| 3 | Critically analyse the advantages and disadvantages of polymers | A | PSO12 |
| 4 | Analyse different Applications of Polymers | A | PSO4 |
| 5 | Identify the properties of polymers. | U | PSO11 |
| 6 | Realize the necessity of biodegradable substitutes for a sustainable development | U,A | PSO12<br>PSO12 |

| **MODULE** | **COURSE DESCRIPTION** | **Hrs** | **CO No.** |
|---|---|---|---|
| **1** | **Introduction to polymers** | **9** | **1** |
| 1.1 | Brief history of macromolecular science, general characteristics of polymers in comparison with common organic compounds. | 2 | |
| 1.2 | Nomenclatures. Distinction between plastics, elastomers and fibres. Natural polymers- cellulose, silk, gums and resin. | 2 | |
| 1.3 | Types of polymers- thermoplastics and thermosettings, functionality concept. Concept of cross linked polymers. | 2 | |
| 1.4 | Types of polymerization- addition, condensation, ionic, co-ordination. Addition – polymerisation – mechanism, | 3 | |

| | | | |
|---|---|---|---|
| | initiation , propagation and termination processes, initiators, inhibitors. Mechanism of ionic polymerization | | |
| **2** | **Methods of polymerization** | **9** | **2** |
| 2.1 | Methods of polymerization-bulk, suspension, emulsion, solution necessity of copolymers and copolymerization, blocks and graft copolymers. | 2 | |
| 2.2 | Thermosetting polymers-examples, synthesis, chemistry, properties and applications of phenol- formaldehyde resins | 2 | |
| 2.3 | synthesis, chemistry, properties and applications of amino resins, urea-formaldehyde and melamine-formaldehyde resins | 2 | |
| 2.4 | synthesis, chemistry, properties and applications of polyurethanes epoxy resins- grades of epoxy resins, curing process and its importance with mechanism , poly carbonates, silicones | 3 | |
| **3** | **Elastomers-I** | **9** | **5** |
| 3.1 | thermoplastic polymers, Polyisoprene, polybutadiene, neoprene. | 2 | |
| 3.2 | synthesis, chemistry, properties and applications of Polyolefins, polyethylenes_HDPE, LDP,LLDP, | 4 | |
| 3.3 | synthesis, chemistry, properties and applications of polyvinyl chloride-grades of PVC, Teflon, Polystyrene-homopolymers, copolymers such as SBR, ABS, SAN. | 3 | |
| **4** | **Elastomers 2** . | **9** | **2** |
| 4.1 | Vinyl polymers- polyvinyl acetate and its modifications like PVA, PVB and polyacetals | 3 | |
| 4.2 | Polyamides - nylon -6, nylon-66 and other nylons. | 2 | |
| 4.3 | Poly ethers and poly esters, terephthalates. Cellulosics such as esters, ethers, acetates, butyrates, nitrate, CMC; regenerated cellulose | 4 | |
| **5** | **Experimental methods-1** | **9** | **2** |
| 5.1 | Molecular weight and molecular weight distribution – number , weight and viscosity average molecular weights of polymers | 2 | |
| 5.2 | methods of determining molecular weight, practical significance of molecular weight distribution, size of polymers. | 2 | |
| 5.3 | Introductory concepts of kinetics of polymerization and Carother's relation. | 3 | |
| 5.4 | Glassy state, glass transition temperature, TGA, factors affecting GTT, crystallinity in polymers. | 2 | |

| | | | |
|---|---|---|---|
| **6** | **Experimental Methods –II** | **9** | **2** |
| 6.1 | Viscosity, solubility, optical properties, electrical properties, thermal properties, mechanical properties of polymers | 2 | |
| 6.2 | Degradation of polymers by thermal, oxidative ,mechanical and chemical methods. | 2 | |
| 6.3 | Polymer processing- compression moulding, casting, extrusion , fibre spinning, injection moulding, thermoforming, vulcanization of elastomers | 2 | |
| 6.4 | Polymer industry in India. | 1 | |
| **6.5** | **Overall advantages and disadvantages of using synthetic polymers** | **1** | **3,6** |
| 6.6 | Necessity of biodegradable substitutes for a sustainable development | 1 | |

References


1. Bllmeyer, “Textbook of polymer science”, John Wiley and Sons

2. D.D. Deshpande, “Physical chemistry of macromolecules”, Vishal publications,

   New Delhi, 1985

3. V.R. Gowariker, N.V. Viswanathan and J.Sreethan, “Polymer Science”, Wiley Eastern Ltd, 1986
4. K.J. Saunders, Organic Polymer Chemistry, 2nd Edn., Chapman and Hall, London, 1988
5. Gowri Sankar Misra, Introductory Polymer Chemistry, New Age International, New Delhi
6. P Ghosh, Polymer Science & Technology, Tata McGraw Hill Eduction, 1991
7. Jeol R.Fried, Polymer Science & Technology, Prentice Hall of India (P) Ltd. New Delhi, 1999.

**UNIVERSITY OF KERALA**

**Model Question Paper of BSc Chemistry Programme**

**2020 Admission onwards**

**Course Code CH1651.3**

**SEMESTER VI ELECTIVE COURSE**

**POLYMER CHEMISTRY**

**Time: Three Hours** **Maximum Marks: 80**

## SECTION A

Each question carries 1 mark (Answer in one word\sentence)
Answer all questions

1. What are elastomers?
2. How is melamine-formaldehyde resin prepared?
3. Write a note on Nylon 66.
4. Mention the monomer unit of neoprene.
5. Define copolymers.
6. Explain extrusion.
7. Define fibre spinning.
8. Explain emulsion polymerisation
9. Give two examples of natural polymers 10. What is SBR and SAN?

## SECTION B

Answer any eight questions. Each question carries 2 marks.

11. Write a note on Condensation polymerisation.
12. Explain the synthesis of HDPE.
13. Write a note on Polyurethanes.
14. Explain number, weight and viscosity average molecular weight.
15. Define graft copolymers.
16. Explain the preparation of PVC.
17. What are epoxy resins?
18. Explain the vulcanisation of ealstomers.
19. Write the mechanism of ionic polymerisation.
20. Explain the chemical methods of degradation of polymers.
21. Explain polymer processing.
22. Distinguish between thermoplastics and thermosetting plastics.

## SECTION C

Answer any six questions. Each question carries 4 marks

23. Write a short note on silicones.
24. What are the methods of determining molar mass?
25. Write notes on (1) compression (2) moulding (3) casting
26. Discuss the synthesis and application of Teflon
27. Describe the role of initiators and inhibitors in addition polymerisation
28. Distinguish between plastics, elastomers and fibres
29. Describe the TGA of polymers.
30. Discuss the various aspects of molecular recognition involved in the structure of DNA.
31. Explain kinetics of polymerization and Carothers relation

## SECTION D

Answer any two questions. Each question carries 15 marks.

32. Discuss the methods of
    (a) Determining molecular weight (9+6)
    (b)Practical significance of molecular weight distribution
33. Write a note on (6+9)
    (a) vinyl polymers
    (b) discuss about the methods of synthesis of PVA, PVB and Polyacetals.
34. (a) Explain crystallinity in polymers (6+9)
    (b) Explain thermal, electrical and mechanical properties of polymers.
35. Write notes on (5+5+5)
    (a) compression (b) moulding (c) casting

**UNIVERSITY OF KERALA**

**Model Question Paper for BSc Chemistry Programme**

**2020 Admission onwards**

| | |
|---|---|
| Semester | V1 |
| Course | Elective Course |
| Course name | **BIO CHEMISTRY** |
| Course Code | **CH1651.4** |
| Credit | 2 |
| Hours | 54 hours |
| Lecture-Tutorial-Lab | 2-0-0 |

| CO No. | COURSE OUTCOME<br>*Upon completion of this course, students* | Cognitive Level | PSO No. |
|---|---|---|---|
| 1 | Recognise the constituents of blood and blood coagulation factors | R,U | PSO21 |
| 2 | Become aware of the role of organs, in maintaining health | U | PSO21 |
| 3 | Realise applications of Analytical techniques and instruments for biochemical studies | U | PSO9 |

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| MODULE | COURSE DESCRIPTION | Hrs | CO No. |
|---|---|---|---|
| 1 | **Blood**<br>Constituents of blood cells and plasma, plasma proteins, albumin and globular - lipoproteins, functions (Details not expected), Coagulation - 'Coagulation factors, Hemoglobin - functions, Structure of hemoglobin, abnormal hemoglobin | 9 | 1 |
| 2 | **Respiration**<br>Chemical and physiological events, affecting diffusion of O2 and CO2 during respiration, Transport of Oxygen in Blood O2 dissociation curve, Interrelationship between O2 and CO2 transport. | 9 | 2 |
| 3 | **Kidney Function**<br>Body water balance, buffers in blood, Formation of Urine, Kidney function, Renal Threshold, Constituents of Urine, diseases associated with Kidney function | 9 | 2 |
| 4 | **Nutrition**<br>Measurement of Energy Value of food , Calorific value, caloric requirement, Kilocalorie. Basal metabolic rate (BMR):- Significance, Condition, factors , measurement | 9 | 3 |
| 5 | **Digestion and Absorption of Food**<br>Outline study of digestion and absorption of Carbohydrates, proteins, fats and enzymes involved , composition and functions of bile - Bile pigments, Bile acids, Bile salts. | 9 | 2 |
| 6 | **BiochemicalTechniques**<br>Chromatography - Ion exchange, adsorption paper, TLC, GLC, affinity, Gel filtration Electrophoresis - paper, gel, ultracentrifugation | 9 | 3 |

**References**


1.Gyton,"Text Book of Medical Physiology".

2. Ganog,"Text Book of Medical Physiology ".
3. David Randall, "Physiology".
4. Dr. A.C. Deb, "Fundamentals of Biochemistry".
5. Swaminathan, "Advanced Text Book on Food & Nutrition".
6. B. Srilakshmi, "Nutrition Science".

**UNIVERSITY OF KERALA**
**B.Sc Chemistry Programme Model Question Paper**

**2020 Admission onwards**

**Semester VI Course Code CH1651 .4 Credit 2**
**ELECTIVE COURSE**
**BIOCHEMISTRY**

**Time: 3 hours** **Maximum marks: 80**

## SECTION A

**Answer all questions (maximum two sentences each question carries 1 mark)**

1. What is the normal pH of arterial blood?
2. What is the cause of sickle cell anemia?
3. Give an example for plasma protein.
4. What are anticoagulants?
5. Define BMR?
6. What is the renal threshold value of glucose?
7. What is NPN?
8. What is the calorific value of fat?
9. Name the bile pigments.
10. What is GLC?

**(10x1=10 marks)**

## SECTION B

**Answer any eight, each question carries 2 marks**

11. Define renal threshold and its significance?
12. What are the normal constituents of urine?
13. What are the different types of hemoglobin?
14. Write a short note on protein digesting enzymes.
15. Draw the structure of heme
16. What are the constituents of blood?
17. What are the functions of plasma protein?
18. What is difference between plasma and serum?
19. What is adsorption chromatograpy?
20. What is the composition of bile?
21. Write about abnormal hemoglobin.
22. Discuss about ion exchange chromatography.

## SECTION C

**Answer any six each question each question carries 4 marks**

23. Explain Oxygen dissociation curve and factors affecting its shift.
24. Describe gel electrophoresis.
25. Explain thin layer chromatography.
26. Explain briefly the buffers in blood.
27. Give an account of diseases affecting kidney function.
28. Discuss about ultracentrifugation.
29. Discuss the physiological events involved in the transport of oxygen and carbon dioxide.
30. Describe briefly about the various blood cells.
31. Briefly explain about lipoproteins and their functions.

**(6 x 4 = 24 marks)**

## SECTION D

**Answer any two (essay) Each question carries 15 marks**

32.Discuss about
(i) Coagulation factors (ii) Anticoagulants (iii) Mechanism of blood clotting.

33. Discuss about the principle procedure and applications of
(i) SDS PAGE (ii) Affinity chromatography (iii) Gel filtration chromatography

34. Describe
(i) Body water balance (ii) Functions of kidney (iii) Formation of urine.

35. Discuss about the digestion and absorption of
(i) Carbohydrate (ii) Protein (iii) Fat

**(15 x 2 =30 marks)**